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NATURAL HISTORY

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1956

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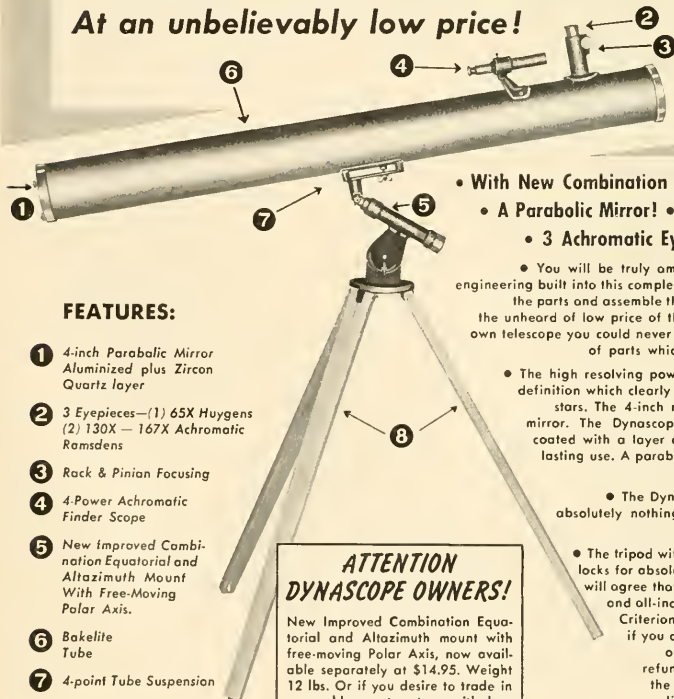
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January, 1956 Volume LXV, No. 1

Mount Hood in Winter Cover Design

From a color transparency by Ray Atkeson

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Through what layers must our rockets — and rocketers — pass before entering the silent darkness of interstellar space?

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An Australian "Sea Serpent" 51

The rare oarfish is the monster responsible for some of the legends

Joyce Burns Glen

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THE COVER THIS MONTH

Old King Boreas is usually in a generous mood when he pays his annual respects to Mt. Hood. Few places in our land receive more snow than the towering volcanic cones of the Pacific Northwest. Though midwinter temperatures are seldom severe even at timber line on Mt. Hood, a single storm can bury the forests beneath a five- or six-foot blanket of snow. Accumulations of 20 feet or more are not uncommon.

Winter sports enthusiasts by the thousand from Portland, just 60 miles away, and other cities flock to Mt. Hood's gleaming slopes. A fine highway skirting the base is kept open the year round, and a short, easy-grade spur road swings up through the forest to Timberline Lodge. Here and at Government Camp settlement on the main cross-country highway, skiers find several chair lifts, many rope tows, and a 3½ mile aerial tramway. Several three- or four-mile ski trails between Timberline and Government Camp yield excellent opportunities for nature study in the winter wonderland of Mt. Hood.

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Letters

Mushrooms on Trees

SIRS:

While on a walk through a neighbor's extensive woodlot this fall, my youngest son and I happened upon a most intriguing sight. This woodlot is rather large for our part of the state and fortunately seldom visited, so that the wildlife is quite undisturbed. We came into a valley densely forested with red pine having numerous dead dry branches, thus constituting a formidable obstacle to easy walking. The floor of this valley was liberally covered with a growth of mushrooms in all stages of development. These mushrooms were of a delicate color and had the appearance of baking powder biscuits that had been lightly browned on top. As pleasing as this view was, it was made more fascinating by the observation that the dead branches of the evergreen trees all about us were decorated with these mushrooms. The mushrooms were inhaled in such a way that the stem was projecting upwards and the cap was down. The effect was that of white candles in the trees. A few of them had the marks of teeth or the bills of birds.

I have never before seen such a curious sight. Could you please tell me what creatures of the forest might have done this and why?

CARL FREDERICK HAMMERSTROM, M.D.
Jamestown, N. Y.

The following information is offered by George G. Goodwin of the American Museum's Department of Mammals:

Strange as it may seem to some of us, squirrels, especially the red squirrel, are partial to mushrooms and toadstools.

Every fall, red squirrels supplement their winter cache of nuts and seeds with a quantity of fungi. Before such perishable goods can be stored they must be cured, or they would soon rot. To process these delicacies, the squirrels hang them on trees, usually on the lower dead branches of evergreen trees, where they will be sheltered from the rain. Here they are left until properly dried and cured; then the squirrels carry them to their storerooms.

However, a wholesale operation such as the one mentioned by Dr. Hammerstrom is most unusual. In fact, it is the largest mushroom-drying project on record. Nevertheless, it was probably the work of squirrels; birds would have no objective in such a procedure. I have frequently seen red squirrels depositing large fungi in trees to dry but never more than five or six in one place.

On one occasion in northern British Columbia, a red squirrel had some toadstools drying in a tree near my tent. Strangely enough, there was no pilfering of the cache by other squirrels at the time, though there were plenty of squirrels in the neighborhood. Unfortunately, this squirrel was shot. Within half an hour, four red squirrels were fighting over the loot, and a fine battle ensued. One squirrel would grab a mushroom, and another would seize him by the throat. Both would then come tumbling to earth, and a third would attempt to seize the spoils. Then still another would show similar intentions, and these two would engage in fierce combat. Finally the mushrooms were broken into small fragments and scattered on the ground. It is strange that these squirrels

should sense so quickly that the rightful owner of the drying mushrooms was dead.

Long Live The Oak

SIRS:

I have long intended to express the pleasure that *NATURAL HISTORY* has afforded me through the years . . . and I can delay no longer after reading Ross E. Hutchins' article, "Many Lives Has the Oak," in the November issue. So here goes an "orchid" not only to Dr. Hutchins for his eloquent and profoundly engrossing piece of writing but to all your editorial staff who produce this fine publication. . . .

(MISS) MIRIAM SACIS

New York, N. Y.

Pioneers in Ancient Wrecks

SIRS:

Mr. Heller's article in the November issue suggests that Dr. Mendel Peterson invented underwater historical research. Surely it would be more accurate as well as more polite to make some mention of the French, who were indulging in such research early in this century, in conventional diving dresses, and in 1947 were officially pursuing studies of ancient wrecks using modern equipment to do so. . . .

P. B. HOME

New York, N. Y.

Kolob Cabin

SIRS:

I "discovered" your fine magazine in the library at Washington State College and was excited to find in the issue for last April an article by Joyce and Josef Muench on the "Five-Fingered Canyons of the Kolob." One of the photographs in this article is of a cabin my father, Gustave O. Larson, built while homesteading that area in the early 30's. [See photo at left.] I remember as a small boy being frightened by a rattlesnake while climbing on the logs near the corner of the cabin.

The area, besides being a place of quiet majesty, has hosted some western history, too, which my father or the prominent southern Utah historian William R. Palmer of Cedar City, Utah, could tell more about. It was a refuge for fugitives from justice, and Indians came there to make arrowheads and other things. Dad took me to a ledge behind the cabin in the picture, where we found several hunting tools chipped from hard quartzite from the copper-pink cliffs.

The materials for the cabin were hauled in, fences were built, and grapes were even transplanted; so it was becoming a second home to us. However, before any private title was secured, the area was declared part of the National Park System, and it now belongs to the people.

G. OLOF LARSON

Pullman, Wash.



Continued on page 54



▲ THREE PONTIFICAL PELICANS mourning their empty pouches.
Photographed at Santa Barbara, Calif., by Vincent J. Mandese.



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WILD AMERICA

----- by Roger Tory Peterson
and James Fisher

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\$5.00, 434 pp., 128 ill.

THIS is the record of a 100-day field trip that started in Newfoundland and ended up in the Pribilof Islands. Through the eyes of James Fisher, one of England's most versatile naturalists, and his guide, Roger Tory Peterson, you see many of our continent's most interesting wild areas. No other book in recent years has provided such a vivid and intimate glimpse of the great variety of wildlife that can be found in North America.

It is always a gratifying experience to be able to show a foreigner the best your country has to offer in his field of interest. In *Wild America* Mr. Peterson lets you share in the fun. Each chapter is prefaced by some comments by Mr. Peterson about the area and then Mr. Fisher lets you read what he put down in his diary. Frequently Mr. Peterson interrupts or summarizes with a few remarks that clarify Mr. Fisher's observations. The book contains 36 chapters, each touching on one of the highspots of the trip. One visits a gannet colony in Newfoundland, the Great Smokies, the Everglades, the Florida Keys, a cloud forest in tropical Mexico, deserts and the desert mountains of the Southwest, the shores of the Pacific, the volcanic peaks of the Cascades, and finally Alaska. In all, Mr. Fisher saw 401 birds that were new to him and Mr. Peterson ended the year with a personal list of 572 North American birds, an unchallenged record for one individual in a year's time.

Mr. Fisher closes his part of the book with a tribute of which we can be proud:

"We Europeans who have not visited North Americans in their homes, read of them and see what the movies show us. Many of us get half a light on half a life—the dollar half. . . . We do not see so well the rugged altruism, the public spirit, the guardianship, the fair dealing of the American at home. Why should they talk of what they take for granted?"

They show us too little of their earthly paradise, and publicize too little their determination to share it with wild nature. Perhaps they have forgotten that they had dedicated National Parks before we in England had even one little, local, private nature-protection society.

Or perhaps they think that to tell of these things would arouse again our not-so-secret resentment at the boast that all that the Americans have is bigger and better, and all that they do is swifter and surer. But do we resent it? Maybe. (If you feel the way you say you do about what you've seen," said Roger, "you tell them, not me.")

"And this is what I have tried to do—to tell of Wild America, and say that never have I seen such wonders or met landlords so worthy of their land. They have had, and still have, the power to ravage it; and instead have made it a garden."

RICHARD H. POUCH

THEODORE ROOSEVELT'S AMERICA

----- by Farida A. Wiley

The Devin-Adair Company, \$5.75,
418 pp., 1 photo, 36 silhouettes

THIS is the third volume in the series of biographical works devoted to American naturalists, the first two dealing with John Burroughs and Ernest Thompson Seton. Theodore Roosevelt was a conspicuous figure in world politics, in national economics, and in so many strictly human activities that it has perhaps been overlooked that he was a great lover of nature and the out-of-doors and one of the early advocates of conservation as a duty to the coming generations.

Most of the pages are given over to selections of Roosevelt's writings, which disclose him removed from the demands of crowded city life and reacting to the wide open spaces. Several introductory essays appraise Theodore Roosevelt as a naturalist, and there is a foreword by his daughter, Ethel Roosevelt Derby.

The chapters follow a chronological pattern from the western cattle country in the 1880's to the Roosevelt Expedition to South America and the journey down the River of Doubt in 1914. In addition to Roosevelt's own words quoted from his books, lectures, and magazine articles, there is a sidelight provided by Leo Miller's chapter on the South American experiences, for the late Leo Miller was a museum collector on that expedition and was greatly impressed by what he saw of Roosevelt's energy and devotion to natural history.

The book is largely narrative, easy to read, and replete with incidents, which quite often have the characteristics of adventure. Several passages are philosophic essays typified by the arguments about protective coloration and the need for conservation measures.

The unique and beautiful line cuts by Ugo Mochi add drama and graceful decoration to the pages of this book.

This is a book to read with interest and leave on the library table as a topic for conversation.

HAROLD E. ANTHONY

WORLDS BEYOND THE HORIZON:

The great age of discovery from
Columbus to the present

by Joachim G. Leithäuser

Translated from the German by
Hugh Merrick

Alfred A. Knopf, \$6.75
412 pp., 59 plates, 44 drawings, 17 maps.

PERHAPS I was not in the proper frame of mind when I read this book, but I can think of no aspect of human endeavor that reveals mankind in a less flattering light than the history of exploration. Naturally there are exceptions, but from the time Columbus annexed the Bahamas until the mid-eighteenth century—when the search for knowledge occasionally joined the search for spoils—the story is essentially a sordid chronicle of greed, murder, intrigue, and worse.

History has rationalized warfare, and occasionally succeeded in making it appear noble, but no one seems to have felt the need to whitewash exploration—at least in its earlier and more lurid phases. Certainly Mr. Leithäuser is enough of a realist to make no such attempt. On the contrary, he has a keen dramatic sense, and in retelling the classic voyages and expeditions from the days of Columbus up to and including the exploration of Antarctica, he makes the most of the material. The book concludes with a short and sober account of the prospects for the exploration of outer space.

In dealing with so vast a subject it is obvious that the author can only hit the high spots. Even so, there are some rather curious emphases. Magellan rates less space than Stanley—but then Magellan wasn't reporting for an important New York newspaper. The Virginia colonies are discussed for pages, while the colonization of New England is dismissed in a short paragraph, which will probably cause the book to be banned in Boston. One can also object to the organization of material, which is topical and regional rather than chronological, with the result that the author is constantly skipping back and forth from one century to

another. On the whole the illustrations are good, although some of the early maps are reproduced so small as to be meaningless. *Worlds Beyond the Horizon* makes interesting, if occasionally depressing, reading.

HARRY TSCHOPIK, JR.

NATIONAL GEOGRAPHIC ON INDIANS OF THE AMERICAS:

a Color-illustrated record

by Matthew W. Stirling, and others

Sold only through the

National Geographic Society, \$7.50

432 pp., 262 illust. in color;

124 photographs, 6 maps.

PROBABLY everyone who is interested in American Indians has wished, at one time or another, that he might turn back the clock and see some tribal group as it was before the native's way of life was destroyed or modified by that of the white man. Imagine the Plains Indian when the West still teemed with buffalo herds; the Pueblo-dwellers of the Southwest when the great cliff-dwellings were still inhabited; the splendor of Maya culture before it mysteriously withered and died. Such romantic daydreams are a part of the lure of anthropological science, but to convert a dream into an accurate picture is a trick involving knowledge, research, and great technical skill.

Over the past fifteen-odd years the National Geographic Society has performed a very valuable service by publishing a series of articles illustrated by meticulously detailed color re-creations depicting the high points of American Indian life from the Arctic Circle to the Andes. These admirable paintings by W. Langdon Kihn and H. M. Herget, showing the American Indian at war, at work, at play, in council and in ceremony, are known and beloved by millions of readers of the *National Geographic*.

It is these paintings that form the core of the present book, although general coverage of the subject has been considerably broadened and amplified through the inclusion of color and black and white photographs, maps, and the reproduction of early prints. The text, much of it by Dr. Matthew W. Stirling of the Smithsonian Institution, is likewise readable and informative. Some sections seem to be entirely new, and where necessary earlier articles have been rewritten and brought up to date. In some cases the revision has resulted in curious situations. Thus, in the article on the Incas, chronological information is attributed to Philip Ainsworth Means that only came to light years after this author's death.

Although the coverage of North America, Mexico, and Central America is probably adequate for popular purposes, articles on South America are limited to

continued on page 52



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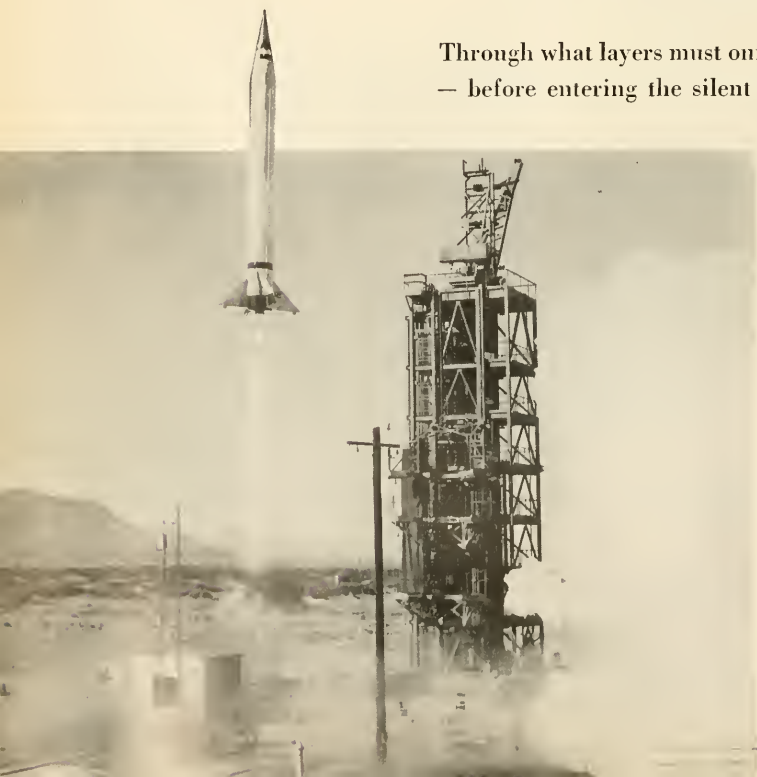


▲ A SECTION OF THE EARTH one-fifth the area of the United States, photographed by the record-breaking Viking II.

Exploring the ATMOSPHERE

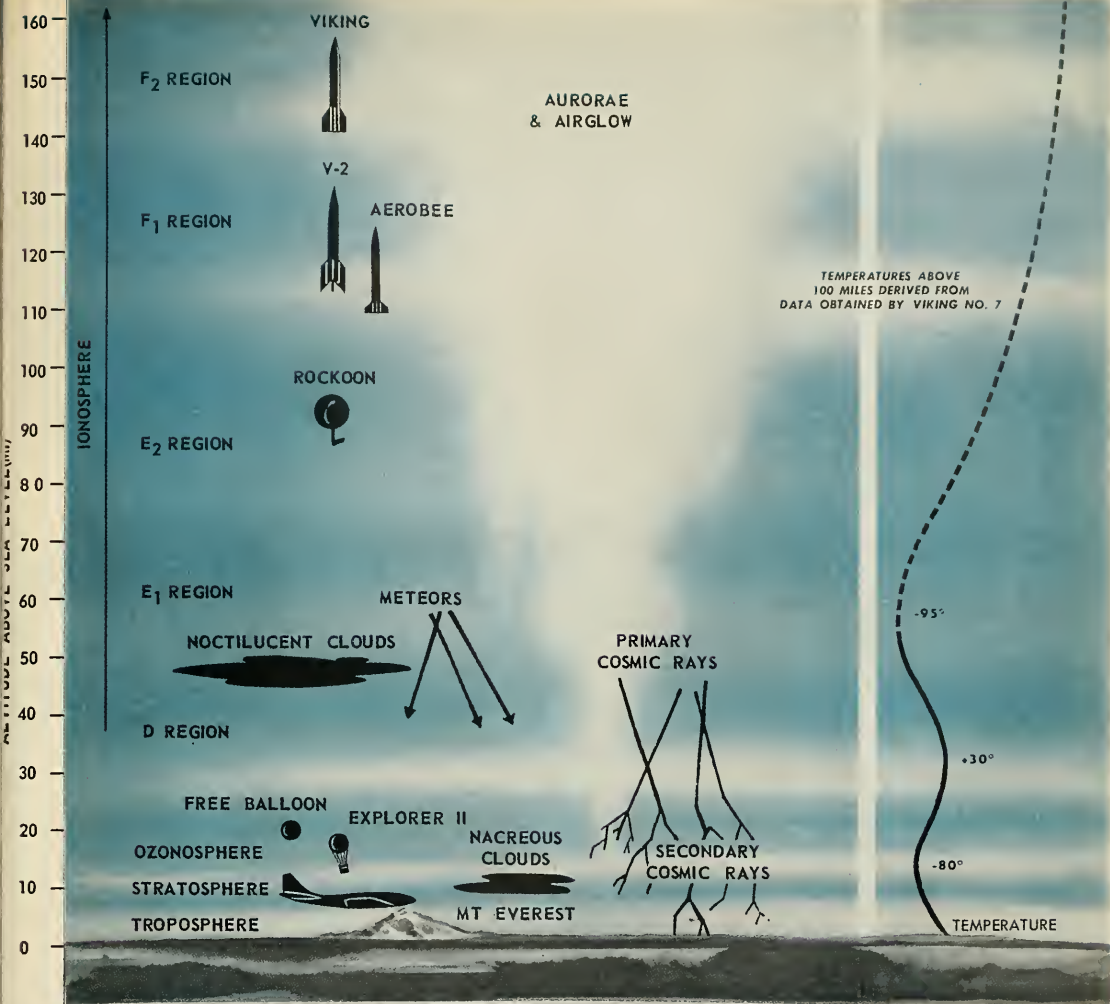
Through what layers must our rockets — and roeketers — pass — before entering the silent darkness of interstellar space?

By HOMER E. NEWELL, JR.*
Naval Research Laboratory



MAN'S continuous quest for knowledge has led him into many strange places. He has traversed the face of the earth, penetrated below its surface, and descended to the depths of the ocean. He has scaled the highest peak and doubled that altitude in piloted aircraft. But a dozen miles or so has been the limit, to date, of his personal explorations aloft.

◀ VIKING 12, shooting toward the ionosphere with a heavy load of recording instruments at the launching in January, 1955.



Much of what's up beyond that level remains to be discovered or confirmed by indirect means—by ground or balloon observations, or by rockets. More precise information about the upper regions will yield the answers to many vital questions relating to weather prediction, air navigation, and radio communications—as well as an understanding of phenomena touch-

ing us in countless other areas of our everyday lives.

The Atmosphere

To set the stage for a discussion of upper-air phenomena, let's begin by defining and briefly analyzing the earth's atmosphere. Lying everywhere between us and the prime source of this world's energy, our sun-screening atmosphere plays

an essential though often mysterious part in maintaining conditions favorable to life on our planet.

The term "atmosphere," commonly used to denote the air we breathe, is scientifically defined as embracing the entire gaseous envelope that presses at all points upon the earth's surface. It includes, in ascending order, regions called the troposphere, stratosphere, mid-

° HOMER E. NEWELL, JR., is Acting Superintendent of the Atmosphere and Astrophysics Division of the Naval Research Laboratory. Born 40 years ago at Holyoke, Mass., he graduated from Harvard and secured his Ph.D. in mathematics from the University of Wisconsin. He taught mathe-

matics there and later at the University of Maryland before joining the Naval Research Laboratory. He has published no fewer than seventeen scientific papers, largely having to do with atmosphere research, instrumentation, and measurement methods. These studies are carrying

science forward on man's geophysical and meteorological frontiers. Dr. Newell is serving on numerous committees concerned with the International Geophysical Year, and with various special aspects of rocketry. He is married and has four children. — Ed.

The mass or weight of our total atmosphere is equal to about one-

The Troposphere

The troposphere blankets the earth to a depth of about seven miles in the middle latitudes, but at the poles it is only about five miles thick, while at the equator it is about

ten miles. This densest layer is composed of roughly four parts of molecular nitrogen mixed with one part of molecular oxygen. It also contains small amounts of carbon dioxide and traces of inert gases, such as helium and argon. The air pressure at sea level is normally about 30 inches of mercury, or 15 pounds per square inch. Temperatures range from a mean of 50 degrees Fahrenheit, at sea level, to minus 80 degrees at the tropopause, the top of the troposphere. Wind velocities mount gradually from the normal 12 to 15 miles per hour at moderate altitudes to over 40 miles per hour at the upper boundary of the

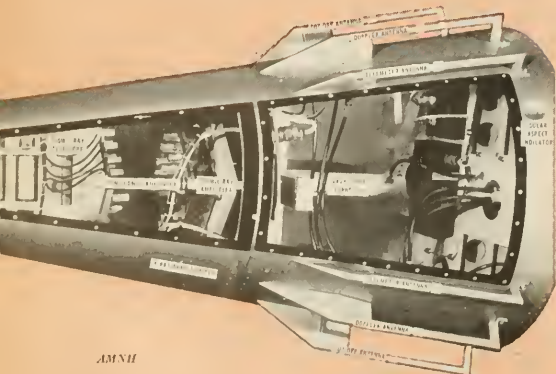


➤ **THIS FULL-SCALE VIKING ROCKET** can be seen in the High Altitude Research Exhibit recently given to the Hayden Planetarium of the American Museum by the Martin Company.

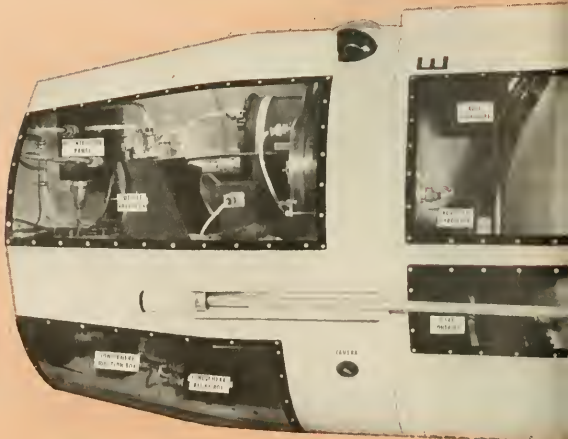
Structural views of the Viking Rocket, showing its instruments and power plant.

NOSE. Cosmic ray telescopes and pressure gauges reside in the cone's forward pressurized part. Unpressurized section aft contains additional instrumentation and antennas.

FOREPART. Cameras for determining cloud formation and racket altitude ore here, also telemetering and dappler instruments, ond cut-off equipment.



AMNIF



troposphere—which happens to correspond to the highest flight of a kite.

Settlements of human beings are to be found in Tibet and in the Andes at 18,000 feet. Sea-level residents, however, require an oxygen supply to sustain consciousness at altitudes over 16,000. Above 20,000 there is scarcely enough oxygen to support the burning of a candle. The peak of Mount Everest stands a little under six miles, at which altitude, within a mile of the tropopause, the daytime sky appears deep purple.

The skies of the middle and lower troposphere owe their familiar blue to the scattering of sunlight in the air. Most of our weather is made in this layer, directly or indirectly as an effect of solar radiation. Thus clouds are formed by evaporation and subsequent condensation, while general large-scale atmospheric circulations are responsible for the movement of pressure areas, cold fronts, and most of the other weather phenomena that characterize the troposphere.

The Stratosphere

The air in the stratosphere is similar in composition to that of the

troposphere but greatly rarified, so that man cannot exist there without carrying along all the oxygen he needs. The airplane has invaded the stratosphere to an altitude of something over 11 miles, and the occupied balloon has gotten to 13½, but the stratosphere reaches on up to an altitude of some 19 miles. Sounding balloons, reaching to as high as 25 miles, have traversed the whole stratosphere.

Diminishing winds characterize the lower reaches of the stratosphere. This layer is not completely quiet as it was once thought to be. Above the 15-mile level, appreciable winds are found. Pressures decrease with altitude, from about 4 inches of mercury at the tropopause to less than a tenth of that at an altitude of 20 miles.

In the upper half of the stratosphere, there exists the major portion of the ozonosphere, characterized by a concentration of ozone. This gas is a special form of oxygen, one of its so-called allotropes, for it has three atoms to each molecule (O_3) instead of two (O_2). It is created by absorption of the sun's ultra-violet rays. The ozonosphere acts as an insulating screen, preventing harmful ultraviolet rays

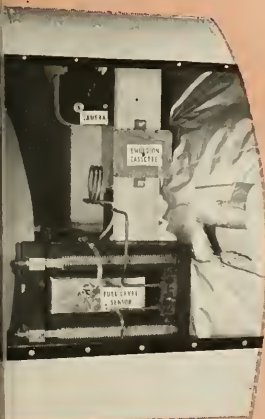
from reaching the earth. Having a maximum concentration of only one part to 100,000 parts of air (at about 18 miles altitude), the entire ozone layer would be less than an eighth of an inch thick if subjected to the pressures we live in at sea level.

Above the middle and higher latitudes, the stratosphere partly lives up to its name, which means literally "the sphere that is spread evenly," in that its temperature varies but little from the 100-odd degrees below freezing reached at the tropopause, though there is a slight increase in temperature setting in at the top. Above the tropics, however, the stratosphere belies its name. There the temperature begins to increase soon after the tropopause is passed.

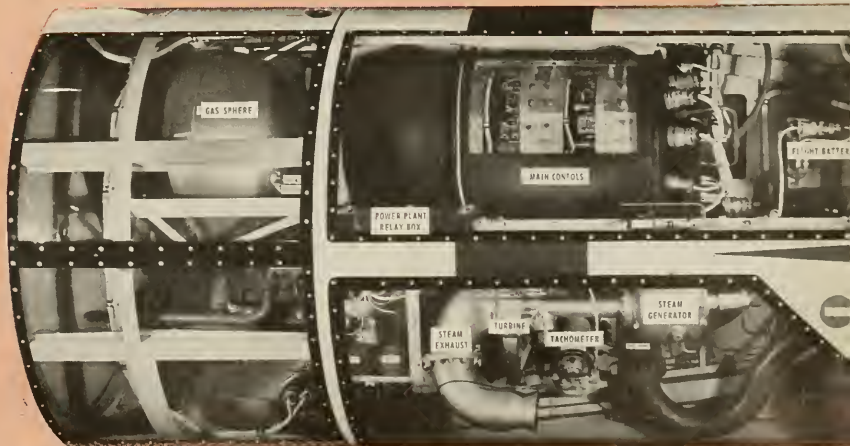
The Mesosphere

Extending from the top of the stratosphere at about 20 miles and reaching into the ionosphere at 55 miles is the middle atmosphere. Including both the upper reaches of the ozonosphere and the lower portion of the ionosphere, the mesosphere is a region of widely differing temperatures and high winds. Wind velocities of hun-

SECTION. Just behind the ethyl alcohol (omitted here) are sensors to measure fuel throughout flight, also high altitude cameras.



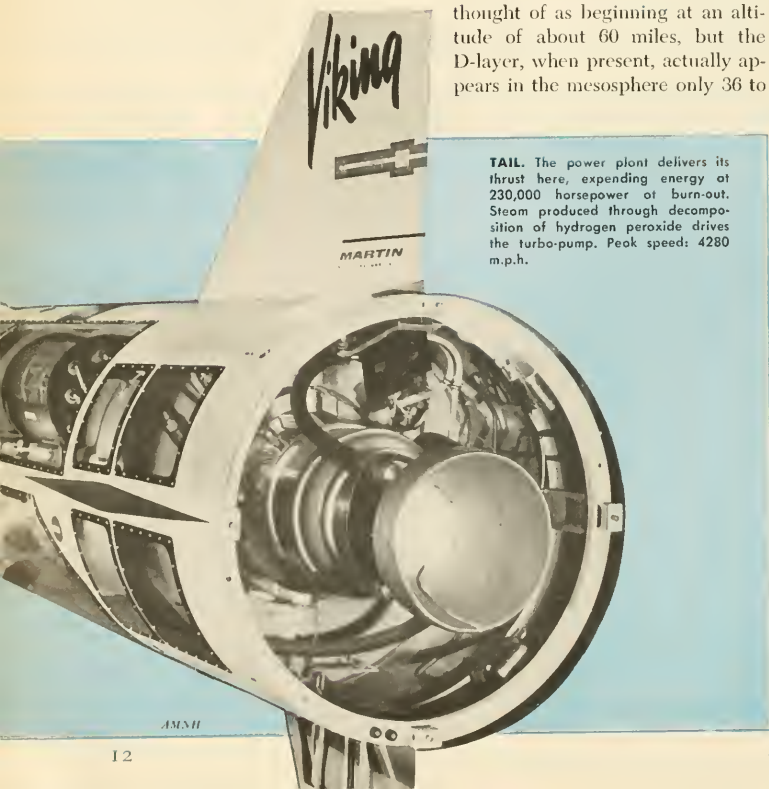
REAR SECTION. Behind a 700-gallon tank of boiling oxygen is a pressure sphere used to pressurize the oxygen and the hydrogen peroxide tanks. Here also is space for power control apparatus, radar equipment, and additional cameras.





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▲ JULES VERNE'S PROJECTILE TRAIN: an illustration that appeared in his book *From the Earth to the Moon*, published in 1865.



TAIL. The power plant delivers its thrust here, expending energy of 230,000 horsepower at burn-out. Steam produced through decomposition of hydrogen peroxide drives the turbo-pump. Peak speed: 4280 m.p.h.

AMNH

dreds of miles per hour are frequent, and average values lie between 60 and 120 miles per hour. It is in the upper part of the mesosphere that most of our meteors become luminous.

Heated by ultraviolet light absorbed by ozone from the sun's radiation, the mesosphere warms up from the stratospheric cold to almost ground level temperatures at about 35 miles. Beyond that level, temperatures fall rapidly with increasing height to a minimum of around -115 degrees Fahrenheit near 50 miles.

At this level occur the highest of all our clouds. These cirrus-like formations of "noctilucent" clouds are visible only at twilight or early in the morning, when they are still in direct sunlight. The sub-freezing temperatures at this height support the theory that the noctilucent clouds are composed essentially of ice crystals, instead of water vapor.

The Ionosphere

The ionosphere is generally thought of as beginning at an altitude of about 60 miles, but the D-layer, when present, actually appears in the mesosphere only 36 to

40 miles above the ground. The ionosphere extends to more than 200 miles above the earth's surface. The pressure of the rarified air, diminishing from 0.00002 inches of mercury at the lower reaches of the ionosphere, becomes virtually negligible at the top of it.

This region is characterized by free electrical charges, the result of ionization of air particles, induced by solar x-rays and ultraviolet radiations. The ionosphere is where many of the electrical and magnetic phenomena of the skies occur, such as airglow and the aurora displays near the earth's poles.

At one time, it was thought that the upper atmosphere was of constant temperature — and quiet. According to present theory, however, much heat is created in the continuous photo-chemical activity caused by absorption of solar radiation. The resulting convection, as well as solar and lunar air tides, cause fairly high winds. Sun spots too, cause disturbances. Temperatures in the upper ionosphere range generally upwards of 212 degrees Fahrenheit, the sea-level boiling point of water.

The so-called D-layer is identified at the bottom of the ionosphere, deep in the mesosphere. Then, at 60 miles, comes the E-layer, a level at which maximum absorption of solar radiations takes place. The E-layer is identified also with the so-called "electrical winds," massive flows of current arising as a result of tidal and thermal motions and affecting the earth's magnetic field.

The upper ionosphere, above the E-region, includes an "F" and perhaps a "G" layer, although the existence of the latter has never been established. The F-region shows a maximum in the neighborhood of 170 miles above the earth. Our present knowledge of these upper regions is gleaned from radio and rocket soundings, and from observations of the aurora, which occasionally reach to as high as 600 miles.

The ionosphere is significant in

another way. It reflects low-frequency radio waves back to earth, making possible long distance broadcasting. High frequency TV waves penetrate this barrier and are lost in outer space—which imposes a line-of-sight limitation on all high-frequency telecasting.

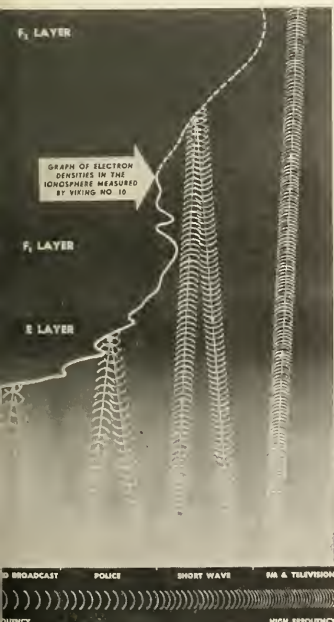
The Exosphere

In this uppermost layer, the atmosphere merges gradually with interstellar space. Random gaseous particles—relatively unhampered by collisions with each other—continually rise and fall under the influence of gravity, occasionally escaping to outer space. The atmosphere is too thin here to screen out any significant portion of the sun's radiation. Nor can it impede the passage of particle radiations such as micrometeorites and cosmic rays.

Rocket Development

During the past half-century, a great deal of material relating to the atmosphere has been gathered by ground-based observers and by

TELEVISION requires relays or coaxial cable because waves pass through ionosphere. Lower frequencies bounce back.



▲ THE ATMOSPHERE filters out harmful rays of the sun's radiation. The shorter the wavelength, the higher it is screened out (see inset). Vehicles like the Viking, are needed to study the sun's composition and energy.

means of balloons. Most of this information, however, concerns only local meteorology—having been obtained from relatively low altitudes. To evaluate the part of the sun's energy that does not reach balloon altitude, instruments must be carried higher by other means.

The rocket has been the obvious answer.

The rocket was an invention of the early Chinese. In British hands, it played an important part in breaking the power of Napoleon at Leipzig in 1813. Nineteenth century speculation about rocket travel was climaxed in 1865, when Jules Verne envisioned a rocket-drawn train of passenger cars in his *Trip to the Moon*.

Realistic further developments in rocketry, however, were to wait another fifty years. Then, Robert H. Goddard of Worcester, Mass., brought space travel within the

reach of science in his experiments using the first liquid-propelled rockets.

Hermann Oberth, an Austrian contemporary, led the research effort in Europe. By 1931, rockets were carrying mail regularly on routes between isolated valleys in the Alps. Such developments laid the ground-work for the V-2 rocket—the design of which was undertaken in 1935. The first successful experimental flight took place in 1942.

Though designed as a weapon, the German V-2 played an important role in early postwar high altitude research. It could carry a ton of instruments to a height of about 100 miles and so was employed to advantage, during 1946, in an extensive program conducted by the Naval Research Laboratory and other research agencies of the Armed Forces.

continued on page 19



A. S. Lockley

▲ *Apus*, the tadpole shrimp (left), is only two or three inches long, but its shieldlike covering makes it look like a horseshoe crab. The other creatures are fairy shrimps, which also appeared in large numbers in Bicycle Dry Lake.

Where did they come from?

When sudden rains filled a dry lake bed that was being used as an air field, thousands of tadpole shrimps appeared as if from nowhere

By ARTHUR S. LOCKLEY

Natural Science Division, Los Angeles State College

LAST August, Bicycle Dry Lake near Barstow, California, was transformed into a shallow, muddy lake by a heavy rainstorm. The lake had rarely had even small amounts of water in it for many years. In fact, the Army had been regularly using it as a landing strip.

About two weeks after a hot spell, someone noticed that the new lake was alive with large numbers of small swimming animals between two and three inches long. An encyclopedia was consulted, and it was noticed that the little creatures resembled trilobites, which have not lived on earth for about 215 million years.

Newspapers, needless to say, suggested that living trilobites had been discovered near Barstow, California!

What was this animal? Where had it come from?

To settle these questions, the Army authorities most generously invited the writer and several colleagues to go to the lake and study the situation at first hand.

The writer identified the animal as belonging to one of the most primitive crustacean groups — the Branchiopoda, or "Gill-foots." Specifically, it was one of the Notostriaca, or tadpole shrimps, which are characterized by a shieldlike car-

pace covering most of the body. It is this shield that makes the tadpole shrimp resemble the trilobites, as well as the much larger marine horseshoe crab.

Our little creature had been known to science for many years as a form living on earth today. It is called *Apus longicaudatus* Le Conte. The genus *Apus* dates back to Triassic times, 190 million years ago. In the United States, it occurs only in the western states. Zoologists had long known of its proclivity to spring up when dry pools get filled by rain.

How can this creature, which obviously depends on water, sur-

vive for long periods where there is no water? So-called "resting eggs" are the answer. The facts are not all known, but observations indicate that during the life history of the population, thick-shelled brown, resting or winter eggs are laid. These are able to withstand dryness and great variations in temperature, unlike the thin-shelled "summer" eggs, which hatch almost at once. When rains or melting snow produce a pond or lake, perhaps as much as several years later, the eggs are released from their mud prisons and hatch.

The form that emerges is much simpler than the adult and is called a nauplius. It develops through a

series of molts—sometimes as many as sixteen—until the adult is produced. This may take only two weeks, but the time depends a good bit on temperature.

In some populations of tadpole shrimps, males are quite rare and the females produce unfertilized or parthenogenetic eggs. These hatch just as do the fertilized eggs produced from the union of male and female.

It has been reported that in Africa, branchiopod larvae have hatched from eggs that have been caked in mud for fifteen years. Perhaps our tadpole shrimps had waited as long. But it's hard to get information like this, because weather stations are not often kept

in operation in the areas where the tadpole shrimps might do their most spectacular performance. True, often the eggs are carried from one place to another by agencies such as wind, birds, insects, or aircraft wheels. But when the outburst is as explosive as it was at Bicycle Dry Lake, it is possible that the tadpole shrimps also came from resting eggs laid some years before.

When the shallow depths of Bicycle Lake became literally teeming with these creatures, ducks and wading birds soon took advantage of the excellent source of food, and the entire appearance of the place was changed briefly—all because of a sudden rainstorm.

▼ THE AUTHOR (left) seining for specimens with a colleague after the Army requested a scientific explanation.




▼ A NET-LOAD of fairy and tadpole shrimps from the temporary lake.



▼ AS THE LAKE began to dry, it left dying shrimps in pools and cracks in the exposed bottom.



Photos by John Reardon



▼ *RAUWOLFIA HETERO-
PHYLLA*, a source of the
"wonder drug" reserpine.

The Root *that relieves* Blood Pressure

A plant remedy from ancient India
proves a boon to sufferers from hypertension and certain mental illnesses

By LOUIS G. NICKELL*

THROUGHOUT most of human history, the botanist and medicine man were one. With the advent of modern scientific medicine, the primitive herbalist lost his prestige. But in recent decades, he has been coming back into his own.

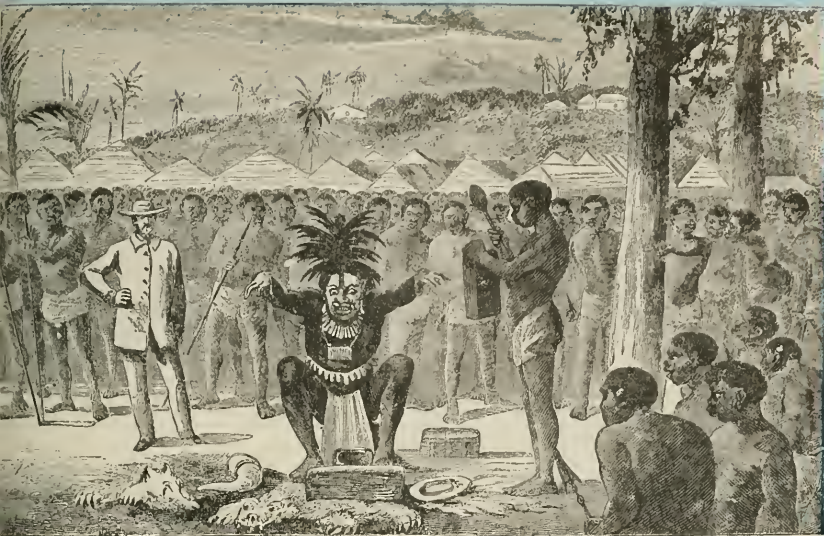
Today's pharmacologist, exploring the plant resources of Africa or South America, must start with the local medicine man, for he is apt to know the properties of almost

every plant in his homeland. It was the wily witch doctor who gave us cocaine, curare, and quinine. And now from classic India comes *Rauwolfia*, from whose roots is extracted a substance that promises new hope to the millions of patients suffering from high blood pressure, certain mental illnesses, and other ailments.

High blood pressure, otherwise known as hypertension, is one of

the more serious causes of the diseases of the heart and circulatory system that kill 41 out of every 100 persons in the United States. Its symptoms may be headache, dizziness, blurred vision, and nose-bleed. Hypertension overburdens the heart, impairs the kidneys, aggravates many organic debilities, and is usually a contributory cause in cases of apoplectic stroke.

Children under 15 who are



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◀ THE WITCH DOCTOR has become a symbol for superstition, but he gaves many drugs, including cocaine, curare, and quinine.



hypertensive usually have an organic disease. By the age of 30, about 2½ per cent of us are hypertensive. The percentage then rises quite rapidly, reaching almost 50 per cent by the age of 50.

As much as 3,000 years ago, *Rauwolfia* was used in India to treat fevers and snakebite. In time, the Hindus came to use it as a sedative and in the treatment of various forms of insanity. In certain parts of India, in fact, the poorer classes gave this drug to their children to put them to sleep, and the practice is still carried on in some areas today. We are told that Gandhi took *Rauwolfia* to sustain him in his program of passive resistance. All this before modern medical science dreamed that this shrub might come to the rescue of millions of people suffering from high blood pressure and other diseases.

Why, after decades of successful scientific use in India, did the drug fail to attract the attention of clinicians in this country? Partly,

because *Rauwolfia* is slow-acting. When an investigator wanted to test its effect, a single dose would not be enough to prove its virtues. It was by accident that successive treatments on the same patient gave the clue. Then, almost overnight, there was sudden excitement over *Rauwolfia*.

Although used in Europe for over 300 years in the treatment of anxiety cases, the drug was not tested to any extent in this country until 1950. Probably the first clinician to work with it was Dr. R. W. Wilkins in Boston. The spur for him was a series of medical articles from India, which reported carefully controlled experiments and modest but firm claims. These excited Dr. Wilkins' interest in the material. His investigations confirmed the results of the Indian investigators.

It is the roots of the plant called *Rauwolfia serpentina* that provide the drug. Scientists had known for many years that *Rauwolfia* roots contained numerous alkaloids. Some of these had been purified

and studied extensively. But the active ingredient could not be pinned down. Finally, a group of Swiss investigators named Mueller, Schlittler, and Bein isolated this new alkaloid, reserpine, in 1952. It turned out to be the most potent of the alkaloids in *serpentina* and was found to be the sole agent responsible for the sedative and hypotensive action for which the root was useful.

Soon after the value of this plant became recognized scientifically, India placed an embargo on *Rauwolfia serpentina*. A search then began in various parts of the world for alternatives or related forms that might contain the precious alkaloid.

Rauwolfia is related to the oleanther and the periwinkle, and there are over 130 different species of it. They grow throughout the world in tropical and semi-tropical regions. In size and shape, they range from small shrubs a foot high to trees over 40 feet high.

Botanical exploration and chemical study have shown to date that the roots of at least three other species of *Rauwolfia* contain worthwhile levels of the important alkaloid, reserpine. One, *R. micrantha*, has the same general geographical

*LOUIS G. NICKELL has made plant physiology his career. Graduating from Yale University in 1942, he served four years in the U.S. Marine Corps and returned to earn his doctorate in 1949. He was em-

ployed as a Research Associate at the Brooklyn Botanical Garden for two years and is now Plant Physiologist and Head of the Phytochemistry Laboratory at Pfizer and Co.—Ed.

➤ AN ARABIAN DOCTOR lecturing on antidotes for snake poison, one of the early uses for *Rauwolfia* in India.

▼ GATHERING HERBS to test their medicinal value. From a German manuscript written about 1200.

Bettmann Archive



distribution as *serpentina* and is therefore not of much help in circumventing the embargo. The second, *R. vomitoria*, is found in considerable abundance in equatorial Africa. The third, *R. hirsuta*, is widespread in both the Eastern and Western Hemisphere, occurring on all continents except Europe. (In technical articles *hirsuta* also goes under the names of *heterophylla* and *canescens*.) At least four more species are now known to contain reserpine, and there is little doubt that still others will be found.

Previous experience with hypertension had taught clinicians to look for certain problems with any new remedy. Many compounds and extracts had been studied, and some had held considerable promise for a time. These included extracts of green hellebore (*Veratrum viride*) and dihydroergocornine, both of which are effective when taken by

mouth. But their limitations soon became evident, as was the case with all other drugs tried. *Veratrum* often resulted in nausea, vomiting, and other complications, and it required extremely careful control in administration. Dihydroergocornine was ineffective in such a high percentage of cases that its usefulness was limited. Then, too, patients became resistant to its action after extended use.

Salient Advantages

Clinicians have found that reserpine lowers blood pressure, slows down the heartbeat, and has a general sedative effect. It is relatively slow in its action yet is compatible with other hypotensive agents, thus allowing combination treatment. For instance, it can be simultaneously used with quick-acting hypotensive agents whose value might in time be lost if used alone. Most

important is the fact that patients taking reserpine have not been shown to develop tolerance or addiction to it.

The drug is still being produced only from the roots of *Rauwolfia* plants. But the chemical structure of reserpine has been determined, and efforts to synthesize it in the laboratory will be made. There is also widespread interest in the possibility of cultivating one of these species.

To illustrate how quickly the use of reserpine has mushroomed, during 1954 (the first full year of use) about two dozen companies were preparing finished products. These products were used in millions of prescriptions, whose sale price was in the neighborhood of 18 to 20 million dollars.

Rauwolfia's effect on high blood pressure is only part of the story. That this new "miracle drug" should also prove its worth spectacularly in the field of psychotherapy becomes impressive when we realize that half of the hospital beds in the country are occupied by mental patients. Besides the hundreds of thousands of bedridden patients, over eight million persons have some type of mental illness that prevents them from performing their normal jobs.

Rauwolfia has been proved to have a relaxing effect on psychotic patients and also on less seriously afflicted persons. In psychiatry, it enables the patient to talk more freely during treatment. Results that are little short of amazing

have been reported in this field. Some of the leading investigators have predicted that if long-term experiments are consistent with the results so far, reserpine will be the most important development we have yet seen in the history of psychiatry.

Though faith in reserpine is not unanimous among psychiatrists, all apparently agree that it should reduce the need for electric shock treatment. This alone would be a boon to psychiatry. The excellent promise it holds in the treatment of schizophrenia was voiced in a recent meeting sponsored by the New York Academy of Sciences, where the use of reserpine in mental and nervous disorders was the

sole topic of discussion. Pointing out that 47 per cent of the in-patients in mental hospitals are in this diagnostic category and that about a quarter of a billion dollars is spent on their care each year, Dr. L. E. Hollister of the Stanford University School of Medicine reminded us that a comparable problem existed no more than eight years ago in regard to tuberculosis. "Since the introduction of effective drugs in the treatment of that disease," stated Dr. Hollister, "the entire character of the treatment has changed . . . It is altogether possible that reserpine, chlorpromazine, and other drugs to follow may cause a similar revolution in the treatment of the mentally ill."

Caution is of course the byword of serious medical research men, but the vast majority are optimistic about *Rauwolfia*. Some go so far as to say that it is the greatest medical discovery since the "antibiotic era" was ushered in by penicillin.

The ancient herbalists of India believed long ago that *Rauwolfia* was a good thing. The white-coated practitioners of modern science have applied the exact scientific method to demonstrate that it is broadly beneficial beyond what anyone might have dared hope. And in the process, we somehow gain new confidence in the search for knowledge and in the vast resources of the plant world.

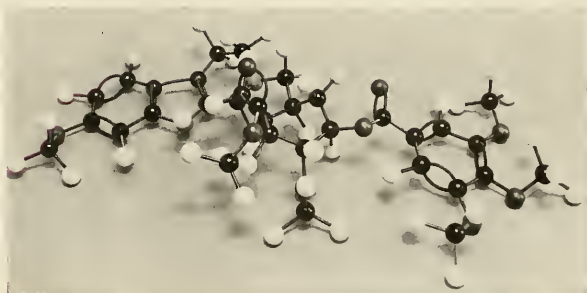


Fabian Bachrach

▲ DR. ROBERT W. WILKINS, probably the first clinician to work with *Rauwolfia* in this country.

➤ KOTARO MURAL FRANCIS A. Hochstein, and W. H. Boegman, who isolated reserpine from *Rauwolfia heterophylla* — the most recent commercial advance in this field.

▼ MODEL showing the molecular structure of reserpine, the alkaloid responsible for *Rauwolfia's* medicinal value.



Chas. Pfizer & Co.



Recently when the author of this article was in New York City, we asked him to tell about the most exciting experience he had ever had during his years of exploration among the wild tribes of Brazil. A self-deprecating smile came over his face, as if to deny that adventures had any connection with his work. But we knew this could hardly be true, for at the age of 46, Harald Schultz had traveled in many little-known parts of Brazil and had pursued his studies among no fewer than seventeen different tribes. After a moment of thought, he said: "I had two experiences that stand above the others. One uneasy time was when I met the Umutinas for the first time. The other was when I left them, under rather uncomfortable circumstances."

We persuaded him that he should write down the two experiences he narrated, and the reader can judge whether his words "uneasy" and "uncomfortable" are adequate. Here is the first. The second will appear in the next issue of NATURAL HISTORY.

here come the Umutinas!

Like so many red devils springing from the encircling forest, they dashed forward with bows drawn to provide one of the most hair-raising receptions ever recorded by a white man meeting a group of aborigines

By HARALD SCHULTZ

Staff Anthropologist of the State Museum, São Paulo, Brazil

All Photographs by the author, SPJ

Part I:

THIS happened in 1943, when little was known of the customs and beliefs of the Umutinas.

I had ridden all day on the back of a truck, traveling through the dry country of central Mato Grosso, following the tracks made by heavy ox carts with wooden wheels. The ruts were now very hard and dusty, and our truck jumped and shuddered without letup. The hot sun burned pitilessly, and we held our eyes half closed against the bright

light as we rode hour after hour.

It was flat open country with grass, bushes, sand, and stones, but on the horizon rocky mountains rose, covered with sparse vegetation.

Houses made of poles covered with clay and with thatched roofs appeared from time to time. As we came closer to a river, light forest took the place of the flatland vegetation.

We were not far from the Jahu-



★ AS THE NATIVES led the author closer to their village, the guide, shown here, blew a horn to announce their approach. He is Atukaré, who became the author's best friend. Note his necklace of jaguar teeth and his sparse beard. The Brazilians call the Umutinas the "Barbados," which means the bearded ones.



▲ ON THIS OCCASION, after the original meeting, Hashipá had been dancing with eyes closed, deep in the spirit of the ritual. When he heard the click of the author's camera, he suddenly raised his knife in a menacing gesture. The author took two steps backwards and forced a laugh. "I do not know what he had in mind," says Harald Schultz. "Perhaps he was making fun, or trying to frighten me."

coára River, which flows to the upper Paraguay in the interior of Mato Grosso. Only a wide section of grassland separated us from the heavier forests of the Paraguay River, where the Umutina Indians

lived. Forty years ago, they had been a powerful and hostile tribe, feared by all. Armed only with bows and arrows and clubs, but with the knowledge of nature that belongs only to an Indian, they had

courageously defended their territory against the white invader. However, they had lost many of their numbers.

We stopped near a big house roofed with sheet metal—the settlement of a trader. His customers were diamond prospectors and ipeacac gatherers, to whom he sold the essentials for life in the jungle so far away from civilization—clothes and medicines, oil, guns, and food, even some perfumes.

° Harald Schultz was born in Brazil, the son of Dr. Wolfgang Schultz and the famous Brazilian singer Joaninha Rasmussen Schultz. Interested in the natural sciences since childhood, he pursued his studies in Germany and then, after 1924, went back to Brazil. In 1942, the great General (now Marshal) Cândido Mariano

da Silva Rondon invited him to reorganize the section of the Brazilian Indian Protection Service concerned with documentary work among the Brazilian Indians, and for five years he directed this work. He has served as assistant to the eminent Brazilian anthropologist Professor Herbert Baldus and has published many papers.

"Are you not afraid to visit these wild animals of the jungle?" he asked me, certainly half joking but also half trying to scare me.

"Why should I be afraid?" I answered, shaking his hand. "I have liked the other Indians I have met. Tell me why I should not like these." I laughed, trying to hide the curiosity awakened by his question.

"Oh, I never trust them completely, you know!" said Senhor Crescencio. "I have lived here for more than 40 years—came as a little boy of about 14, worked hard, and now I am the owner of this trading post. These Indians have killed many good people."

"Yes, I know that very well, Senhor Crescencio, but the Umutinas

were pacified in 1911 by Helmano dos Santos Mascarenhas. And that is a long time ago. So why do you fear them still?"

"To be honest, Senhor Haroldo, they have never done any harm to me or to any member of my family. Many years ago they came to my house from time to time, trying to obtain presents. Only men came. Later they also brought their families, and this is always a sign of peace and trust. They needed iron tools—axes, knives, scissors—but my wife and I have never trusted them completely. In our opinion, they are animals of the forest, wild cannibals, and we don't want them."

"Why do you call them cannibals? Do you have any reason to

think that they eat human flesh?"

The trader laughed ruefully. "Senhor Haroldo, you don't know with whom you are going to deal. Years ago they ate the heads of their dead enemies. I hope they will not eat yours."

He was joking, but there was something serious behind what he said.

"How do you know this?"

"Very simple. One of my servants was taken prisoner by the Umutinas when he was a little boy. He is old now, but he often talks about what he saw. They did not kill him—he was too young—, but they killed a man they caught with him."

"Do you know the details—how it happened?"

"Oh yes, I have heard the story often, but perhaps you would rather hear it at first hand."

I nodded.

"Raimundo! Raimundo!" he called. "Come here and meet this gentleman who wants to visit the Umutinas. He says he is a friend of all Indians. Ha-ha-ha!"

An old man appeared and said, "How are you?" He looked like one who has worked hard all his life but earned very little.

"Thanks, I am very fine," I said. "And how are you?"

Senhor Raimundo nodded.

"Tell him your story," said the trader.

Raimundo sat down on the trunk of a tree and started to talk:

"When I was a very young fellow—I do not remember exactly how

▼ A STRONG YOUNG MAN and a good hunter: Katulá, Jakuepá's eldest son. Though he has his own fields, he is as yet unmarried. The Umutina men tie their hair up in this fashion and pluck their eyebrows.



old—we were out in the jungle looking for a medicinal plant that grows here in abundance. The price was high, and we all needed money. There was plenty of game, and we could stay in the jungle for a long time. We went far into the forest, never thinking of the danger of Indians or wild animals. Then one day we were suddenly surrounded by a large group of Umutinas, who must have been on a hunting trip. One of our men did not wait. He only shouted, 'The Indians!' and started shooting his rifle. He killed one of the Indians.

"I don't know whether these Indians had come to attack us or not. If so, I should think they could easily have killed us with their arrows, because they were hiding behind big trees. Anyway, after we

had killed one of them, they became furious, almost like wild animals. They jumped at us and beat us with their heavy clubs, which were made of hard black wood. Two of our group were killed on the spot, but I and the man who had shot at them were made prisoners.

"They tied us up with vines and then started talking to the man who had killed one of them. They always said the same word, repeating it over and over. We did not understand it. But suddenly the man said to me, 'Raimundo, I think I know what they are saying. Someone told me once. They are asking my name. I think they want to be our friends. Perhaps they are not going to kill us.'

"He started laughing excitedly



▲ THE ONLY YOUNG GIRL of marriageable age in the Umutina village: Jukuepá's daughter. She could not marry, because all were too closely related to her. When they proposed that the author become her husband and he laughingly asked why not, she said: "That would be no good, because you do not like the way I prepare my food."

▼ A MISCHIEVOUS YOUNG GIRL of the tribe, who kept looking into all the author's boxes until he put her in charge of guarding them from the others.



▲ THE AUTHOR and his Umutina friends. The women's skirts are woven into a continuous band, without beginning or end.



▲ AN Umutina HOUSE, showing the characteristic sloping straw wall. The men build the houses, but they belong to the women.





◀ FIRST STEP in a fish poisoning expedition: bringing the timbó vines, which contain the poison.

▼ THE VINES are beaten and then carried into the pool so their juice can be mixed with the water.



▼ SPREADING the lathery juice through the pool. The chief of the party watches to see that all his helpers do a thorough job. It may take two hours to treat every portion of the pool.



▼ SPECIAL BOWS AND ARROWS are used for shooting the drugged fish. The man will shoot all four or five arrows before collecting the fish. Each person collects for his own family. The poison only suffocates the fish and in no way affects their food value.



and then said his name, 'Felisberto,' and repeated it whenever they spoke. The Indians tried to pronounce the name and asked him over and over. Finally one of them could say 'Felisberto' more or less correctly,—the one who had caught him—, and then it happened.

"One of the other Indians had been standing behind Felisberto with a club in his hands, and the Indian who had caught him gave a signal with his eyes. The man behind Felisberto then struck him on the head so heavily that he fell to the ground dead, without sign of pain.

"After awhile they cut his head off and started a fire. They boiled the meat for about two hours. Then they started eating it, but vomiting part of it because of aversion. The man who had killed Felisberto collected the teeth from the skull and later made a necklace for his wife." Raimundo was now visibly disturbed by the memory and interrupted his story.

"But how did you escape?" I asked, "Why did they not kill you?"

"Probably because I was too young. I was only a boy. Later I learned why they killed prisoners and ate their heads. They only ate the heads of strong, dangerous, and courageous enemies. They believed that by doing so they would gain the victim's power and courage and his good qualities as a warrior. It

was a kind of an honor to the enemy killed, and again there was a special reason related to the belief of the eternal life of the soul. Names belonged to certain families or family groups. Other families could not use them. Names were as much a possession as a precious stone is among us."¹

"What did they do with the other bodies—the two they had killed? Did they eat them, too?"

"No, they pushed them into hollow trunks of rotten trees. Their movements were full of haste, and they seemed to be hateful. They carried home the Indian who had been killed by Felisberto, loudly crying while they marched through the forest. They buried him in his own hut. He was the father of two small children. His wife slept upon his grave on her straw mat."

"Did they mistreat you?" I asked. "How long did you live among them?"

"They were very kind to me. Nobody ever showed any anger toward me. But I was unhappy. Their food was very strange at first, and I kept watching for a chance to go back to my parents. One day, after a couple of weeks, perhaps months, they went on a trip to catch fish by poisoning one of the lakes. All the Indians were leaving the village, so I had to go with them. But when they became busy killing fish, they seemed to forget about me. I hid behind a big tree; then I started walking quietly. Pretty soon I began running as if the devil were after my soul. I had taken careful notice of the direction I would have to go if I were ever to escape. The forest on the borders of the upper Paraguay is not very wide, you know, so I was able to get through it in two hours. Then I started across the open grassland."

The old man drew a deep breath and narrowed his eyes. "This was many, many years ago," he went on. "The war between the Indians and the white man later became

more intense, and then came the pacification. But with the pacification came also the contact with the white man, and the diseases that followed killed more Indians than bullets ever could."

"How many Umutina Indians do you think existed when you were their prisoner?"

"I am a simple man, Senhor, and I cannot be responsible for an exact number. I think there were several hundred of them in more than three or four villages. They were like ants in the one village where I lived. There seemed to be struggles among different groups. And they killed each other for reasons I could not understand."

To the Point of Contact

Later, when our truck was ready to start again, the trader gave me friendly encouragement: "Good luck to you," he said. "I'm sure you will like the Umutina Indians. The devil is never as black as he is painted."

I thanked him, and we traveled through the flat grassland to the Paraguay River, crossing it by a shallow ford. I was thinking about the boy who had been captured by the Umutinas when we came into sight of the post of the Brazilian Indian Service called *Fraternidade Indígena*, which means "Indian Brotherhood."

There was a large square formed by the administration buildings, an Indian school and nursery, and two rows of small houses occupied by Indians—a total population of about 200.

Senhor José Ferdéis was in charge here. He greeted me and learned the purpose of my trip. "You can't visit the Umutina," he said, "without first being invited by them."

"I have come just to study them," I said.

"I will send a messenger, one of their relatives, to tell them you are here and want to meet them."

"Tell them I have many axes, knives, and other useful things for them," I suggested.

The messenger left the same day. The only thing to do now was to

¹ All this information was verified later by the author when he lived among the Umutinas for more than eight months. The fact about eating dead enemies is known not only from the Umutinas but from many other tribes of Brazil, as for example the Tupi of the Brazilian coast during early colonial times.





▲ BACK HOME, the fish are sealed and cleaned. Some are boiled and eaten at once. The larger quantity are dried on a rack. Several weeks later, the dried fish will be ground and mixed with pepper and corn flour, then cooked as a paste. The author pronounced it "horrible," but the Umutinas love it.

wait. A near-by creek of clear water invited us to swim, and the day passed quickly.

Later, when we were in front of the agent's house chatting, I asked: "When do you expect the messenger to get back?"

"He will be back soon, I think," said Senhor José Ferdelis.

Just then, one of the others said, "Look at that! Smoke in the forest."

A column of smoke was rising far in the distance.

"I think it is a sign that the Umutinas are coming," said Senhor José Ferdelis.

After awhile, another smoke signal appeared, this time closer. Somewhat later, a third rose, now only about half a mile away.

I was getting excited, for I had traveled far to see these Indians and was sure they would prove to be interesting. But I was not prepared for anything so frightening as was to occur. It happened all of a sudden.

Red spots jumped out of the forest about 200 yards from where we were sitting, and the Umutinas came charging toward us. They looked like devils popping out of hell. They were painted red from head to foot — bodies, arms, and legs—, but their faces were stripes of black, yellow, and red. They carried long heavy bows and arrows. As they ran toward us, they shouted and jumped; and then they all stopped, drew their bow strings, and aimed directly at us!

Surely, I thought, they aren't going to attack us.

If a band of Indians like this all shoot at once at close range, you are practically certain to be struck. The chances are that one volley will leave you bristling like a pin cushion. I could scarcely believe my eyes; but the next moment I heard their bow strings twang!

I waited to be struck, every muscle tight. But no arrows came.

The Indians then ran backward

a short distance, stopped, and jumped to both sides. A moment later they charged again. At about 50 yards they stopped once more, drew their bow strings, and pointed the arrows at us. I could see their angry-looking faces, their exposed teeth. The strings of the bows sang again, and my heart pounded, but the arrows did not fly. How the warriors could so skillfully stop the arrows from sliding through their fingers I could not imagine.

Again they rushed forward, jumping grotesquely from side to side, and then another volley. Now they were so close I could see their arrows were tipped with metal points made from knife blades. So it went, charge after charge. Their gruesome shouts and the twanging of the bow strings filled our ears. Every minute I thought this cat-and-mouse game would end and that one of the arrows would come flying toward me.

The Indians were now trembling

all over, but I sensed that the emotion was not anger; it was excitement and fear — fear at meeting white people. Actually their performance had not been an attack but was their usual form of greeting. Instead of walking up and shaking hands, it was customary for the Umutinas to put on a full-fledged attack—all except letting the arrows go.

Then they came close and spoke in whispers, repeating the same word over and over: "*Mistekame, mistekame.*" They said it ten times and more.

"They want to know your name," said José Ferdelis. "*Mistekame* means 'Who are you? What is your name?'"

"*Mistekame* — Haroldo," I said. Each time I spoke my name, they tried to pronounce it, at first badly, then better. At last, they pronounced it "Haroodo." Now it was my turn to know the name of each of them.

The eldest was Jukuépa, his two sons Katulá and Julapáre. Jukuépa's brother-in-law was Hashipá.

They were calmer now, and I delivered to each a steel axe and a pointed knife. Jukuépa returned the gesture by presenting me with a beautiful arrow adorned with pompons of white down and with guide feathers taken from eagle wings.

No More Axes

Later, a single Umutina burst out of the jungle—a thinner man than any of the others but very muscular—and went through the same performance, ending by asking my name just as the others had.

Now, however, there was a problem. I was out of axes and had only one pointed knife left. All of the other Indians had gotten an ax as well as a knife.

Senhor Ferdelis said: "Now you will have an enemy. He will expect an ax and you have none."

There was nothing else to do, so I handed the Indian the knife. He looked at it, then looked at the axes the other Indians were holding. Suddenly he started jumping again. He trembled throughout his body,

raised the pointed knife in his fist, and jumped toward me. Hate flashed in his nearly-closed eyes. His face, being completely covered with paint, did not reveal any other feeling. He then brought the point of the knife down to my shoulder at the soft place between the collar bone and the shoulder blade. My heart was pounding. I could see the knife trembling under the man's hand. He held the point there for what seemed like minutes.

I could not stop the impulse to move backward two steps, but he followed me. I'm sure that my face must have been pale. I tried to laugh but could not. There was a strange feeling in my spine. The Indian pressed the knife downward, and I thought surely he was going to drive it into me. Then he started whispering the same "*Mistekame, mistekame* (Who are you, who are you?)."

"I am Haroldo," I answered and kept saying it until he knew my name correctly.

Strangely enough, this Indian, Atukaré by name, later became my best friend.

Our interpreter was the same Indian who had taken the message to the Umutina village. "They have been out fishing," he said, "killing fish with the poison called timbó. There were plenty of fish, but the Indians complain that there is a lack of manioc flour and raw sugar. They want you to come with these things at once. They say they will be glad to have a guest in their village."

I promised that I would start on the morrow, explaining that manioc flour and raw sugar would have to be bought back at Barra dos Bugres.

The Indians rested a little, eating boiled beans and drinking the refreshment offered by the manager. Then they started the march back to their village, about 40 miles inside the jungle.

The next day a dugout, paddled by twelve strong arms of civilized Indians, took us upstream. Two days later we arrived at the Umutina village.

Long before our arrival, a horn was blown to announce that we were coming. The Indians in the village answered in the same way, indicating that we were welcome.

There was no ceremonial "welcome attack" this time. Two young Umutinas, their whole bodies painted red, were waiting for us.

A Ghostly Village

It was already dark, and it was raining lightly. The houses were not very far from the shore, looking like mounds of straw in the dark. Dogs were yelping, children crying in fear. The women came close to see the strange visitor. Many tamed birds of the forest were ambling around the clearing, and two tall black-headed storks were standing near the fire, like two human beings trying to get warm.

"Why so many pet animals?" I asked.

The answer did not come easily, but in time they told me:

"Some of them already contain the souls of dead Umutinas, others are waiting to get them. All of us choose the animal we will live in after death."

The spooky storks, the gloom and rain, everything oppressed me. I was tired, and my mosquito net was dripping wet. "This is a bad place," I said to myself. "But it's not a time to complain."

Jukuépa was hospitable. He gave me a place to hang my hammock between fires that were burning on the floor in one of the huts. He offered me a present of welcome—a very finely made club of heavy black palmwood, similar to a sword. Hundreds of fish were smoking on drying racks, and he offered me some for dinner.

This was the beginning of my long sojourn among these interesting Indians. That night, trying to sleep in my hammock, I kept thinking of that hair-raising greeting and hoping they would not show me a real fight. ★ ★ ★

Next month, Harald Schultz will tell how he was almost killed among the Umutinas and of the strange part played by Atukaré, the Indian who got only a knife.

AN ANCIENT PRACTICE

PRESENTED FOR THE FIRST TIME

At the frigid fringe of the inhabited world, these fur-clad figures from out of the primitive past travel by dog sled from 10 to 40 miles onto the sea ice for the winter walrus hunt. Their life depends on it. In their heads they carry the timeless techniques that have permitted them to survive in a world of tooth and claw. Beneath their furs they wear the amulets that will help their luck in the hunt. In their hearts they know that some may be carried out to sea on broken ice, never to return. But the tribe must live on. Six sleds and 85 dogs took part in this hunt.

▼ OLD SHAPUNGALOK almost didn't make it. He was marooned for nine days on drifting ice.





▲ AT THEIR HUNTING CAMP on newly-formed ice, they climb a pressure ridge to look for walrus. Wherever a lead of open water forms in the moving ice, the animals may be sighted. Or a walrus may break through new "rubber" ice at any time to breathe.

Walrus Hunt

One of the most hazardous pursuits in the arctic is the annual walrus hunt of the Iglulik Eskimos, who give us a glimpse of what life may have been like in the Middle Stone Age

A Photo Series by **RICHARD HARRINGTON***
From Three Lions

Text by **EDWARD WEYER, JR.**
Editor, NATURAL HISTORY MAGAZINE

EVER since William Edward Parry discovered this group of Eskimos on his second voyage (1821-23), the Iglulik Eskimos have attracted scientific interest. But owing to their inaccessible location at the head of ice-choked Foxe Basin, few explorers visited them until fairly recent times. Their winter walrus hunting has probably not been witnessed by more than half a dozen white men, and no photographic record had been made of it until Richard Harrington undertook a special trip for this purpose.

He writes that his journey by dog sled from Repulse Bay northwest of Hudson Bay to the Eskimo settlement on the island of Iglulik, a distance of some 250 miles, was the toughest trip he ever made. With him was an Iglulik Eskimo named Kalaut. They had to travel

* Richard Harrington is the author of *The Face of the Arctic*. In addition to extensive travels in the north, he has also photographed native peoples as far south as Tierra del Fuego and in Australia and the islands of Polynesia.—Ed.



▲ IF ONE OF THE SCATTERED GROUPS of hunters hears a walrus emerge, they run toward the breathing hole to frighten it. By the time they reach the spot, the animal may be out of breath so that the hunters can more easily harpoon it, as they have done here. The second man stands ready to help kill the animal. Sometimes a lance is used, sometimes nowadays, a rifle, but they shoot sparingly lest they scare other walruses away.



▲ THE ICE is chopped away to get the walrus out. The dogs, as well versed in their part as the men in theirs, stand ready to help.



▲ A FREQUENT accident. Pressure has caused sheet of ice to come slithering over the hole where

into the teeth of the wind most of the way, and at times the gales prevented any movement. It was the month of January, at a time of the year when there is barely any daylight at that latitude. Toward the end of the journey they ran out of food. The trip took nearly twice as long as it should have.

Survivors from the Mesolithic

The Iglulik Eskimos are interesting because their mode of life is extreme even for Eskimos, living as they do at the edge of the inhabited world in the central arctic. In technology, they represent a stage comparable to the Middle Stone Age.

Modern studies of the Iglulik Eskimos have been made by Therkel Mathiassen, the late Knud Rasmussen, and others. But equally important in one sense is the fact that when William Edward Parry discovered the tribe, he and his second-in-command, G. F. Lyon, recorded detailed observations on their life and thought before civilization could have had any effect on them. Thus in the description these men give us of their winter at the village of Iglulik, we have a pristine glimpse of the habits and beliefs of a nature-people, unmodified by any influences that might blur the view of this much earlier stage of human existence.

We cannot compare their marriage customs with those of Stone Age man, because little is known of the latter. But it may be noted that the explorers found the tribe living in a state of flexible monogamy, freely exchanging their wives under certain circumstances and showing little evidence of marital jealousy. It is possible, from what Stefansson has reported from the Eskimos of Coronation Gulf to the west, that the Iglulik Eskimos did not know "the facts of life."

In hunting techniques, they showed elaborate specialization. Summer found them scouring the country for caribou. During the winter, they lived in snow houses along the shore and hunted sea mammals out on the floating ice. Life for them hung upon the bow string and harpoon line, and they shared their food communally.

Like other tribes among the Central Eskimos, the Iglulingmiut were hampered by many taboos intended to avoid contact between products of the land and products of the sea. At walrus hunting time, instead of using a moss wick in their seal oil lamps, they were required to use only a wick molded of powdered walrus ivory. And they could not wear boots that had been used while salmon fishing.

On the practical side, however, the Iglulik Eskimos offer brilliant

examples of the ingenious use of extremely limited materials. So far beyond the limit of trees, driftwood is rare, and these Eskimos are sometimes forced to make a sledge out of wet walrus hides, folded up and frozen. The snow house itself is a classic example of ingenuity, with its window of ice or gut.

The walrus hunt illustrates how vital and indispensable a weapon the harpoon is to any people who live by sea hunting. On land, the wounded animal can be pursued, by dogs or men. But at sea, to injure an animal simply by gun or lance is almost certainly to lose it, for it will sink or dive and come up far away if at all. To prevent this, primitive people many centuries ago invented the harpoon to hold the stricken animal on the end of a line. This implement has permitted the survival of tribes in regions otherwise uninhabitable. The head of the harpoon upon entering the body of the animal, becomes detached from the shaft and turns crossways beneath the skin like a toggle, with the line attached to it and held by the hunter.

Even when the harpoon strikes its mark, however, the task of landing a walrus weighing a ton or a ton and a half is difficult. If not careful, the hunter can be caught in a coil of his own line and dragged from the slippery ice to



the walrus was. The Eskimos are in danger of losing their catch, their dogs, even their own lives.



▲ A NEW CHANCE to save the day. The dogs are hitched to the carcass, and the hunters urge them to their utmost. Men and dogs pull frantically to forestall another fiasco on the shifting ice.

drown in the frigid sea. His objective is to snub the rawhide line around the harpoon shaft, which he has stuck into the ice, and to draw the animal close enough to kill it by spearing. Two or more always work together at this.

For hauling the carcass up onto the ice, the Eskimo has devised so astonishing an equivalent of the block-and-tackle that some suspect he may have borrowed the idea from rigging seen on the early ships of the white man. He fastens one end of the line to the walrus' nose. He then passes the line around the upright harpoon and back to the walrus, threading it through a loop cut in the animal's hide. The hunters then pull on the free end, and the line slides through the slits in the hide as through a pulley. This gives them a mechanical advantage of approximately two to one over a straight pull, except for a slight amount of friction. Sometimes the hunters run the line around one of the walrus' tusks instead of through a loop in the skin. This suggests a way in which the people may accidentally have discovered the principle in the normal course of their work.

A Difficult Assignment

"Photographing this operation," writes Mr. Harrington, "was the most grueling project I have ever

WALRUS HUNT



▲ OUT ON THE ICE at last: a female walrus weighing something over 1000 pounds. The hunters are now chortling with glee.

➤ THE TUSKS are in considerable demand. They provide ivory for harpoon heads, toggles for dog tracers, and other implements.





▲ THE MAN who harpooned the animal gets his choice of the meat, usually the forepart. But otherwise, food is divided communally among the Iglulik Eskimos, for today's fortunate hunter may be tomorrow's "hard luck Harry."

▼ BACK ON SHORE, Shapungalok's frozen feet are treated by the manager of the trading post. Notice the fatigue and pain written on his face after nine days near death on a floating cake of ice.



carried out. The hunters usually return at night from the drifting ice, as no shelter can be erected where there is not even snow suitable for a snow hut. But the hunters are often marooned for days on the ice, and every year some men freeze to death.

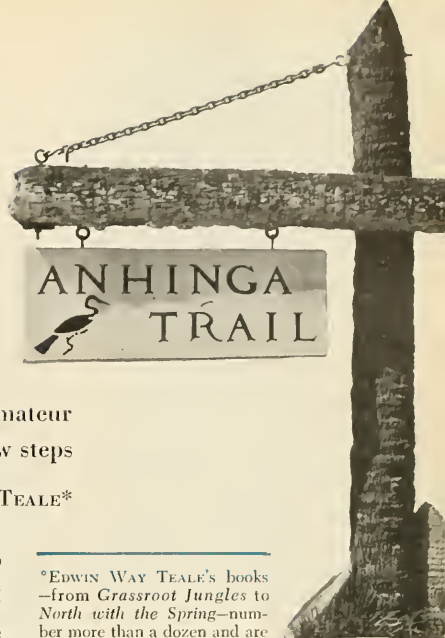
"A constant spray was drifting off the open water, covering our fur clothes and chilling us thoroughly. The surface of the ice was wet, and it was almost impossible not to sink into the water at some time or other, especially when crossing new ice. When looking around for the best points from which to take pictures, I always had to keep a close watch for new leads suddenly opening up in the ice, and they often did, almost under my feet. Another hazard occurs when the advancing ice builds up upon itself until its own weight causes sudden breakage and sinking. Once when a sheet of ice slithered over the piece on which we were standing, we almost lost our equipment and I recovered my gloves just as they were disappearing under the advancing sheet.

"Since the hunting is always done when the wind is blowing off the water, bringing fog and mist, it is impossible to get clear, sharp photographs of this. And if the wind shifts to an offshore position, it is almost certain death to remain on the ice, because vast cakes break off, drift loose, and become broken into small pieces."

• • •

By the time the Eskimos with whom Mr. Harrington was working had secured their first walrus, he seems to have grown sufficiently tired and hungry to rejoice equally with his companions, for he writes: "But there was adequate reward for all the hardships we suffered. The first walrus was split open swiftly and the stomach lifted out. There, inside, we found the choicest tidbits of half-digested sea food. We ate the crabmeat and clams and found them just nicely seasoned by the gastric juice of the walrus."

Everglades BOARDWALK



The Anhinga Trail is a photographic paradise for amateur and professional alike, and you only have to walk a few steps

By EDWIN WAY TEALE*

NOWHERE else in America will 150 paces carry you among greater concentrations of spectacular bird life than on the Anhinga Trail in the Everglades National Park, in southern Florida. Only 40 miles southwest of Miami and two miles beyond the entrance to the 1½-million-acre government sanctuary, this wildlife boardwalk zigzags northward into the heart of an area such as an explorer

might journey hundreds of miles to see. Yet the trail is as easy to travel as a sidewalk, for it is built of planks supported by piles over the water and land of Taylor Slough. Over it, tens of thousands from all over America and from many foreign countries have entered a world of creatures that live their natural lives in a wilderness relationship older than the Seminoles.

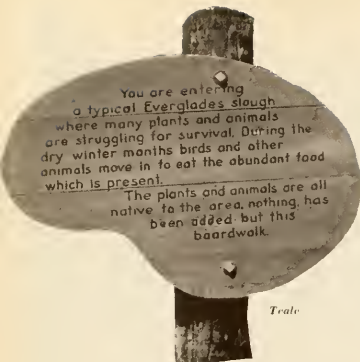
It was nearing sunset on the last

*EDWIN WAY TEALE'S books—from *Grassroot Jungles* to *North with the Spring*—number more than a dozen and are so well known that he needs no introduction. He has received the respected John Burroughs Medal and has contributed articles to *NATURAL HISTORY Magazine* ever since 1941 when his interest in nature compelled him to leave an editorial career to devote himself exclusively to writing. He is active in a wide assortment of scientific societies and has been president of the New York Entomological Society.—ED.

▼ LOOKING TOWARD THE END of the Anhinga Trail, where the boardwalk broadens to provide camera space for visiting nature photographers.

Edwin Way Teale





The birds and the animals here are never fed. They are living

day of February when I first came to the Anhinga Trail. Wherever I looked, as I stood at the vantage point of its farther end, the life of the Everglades was in action. Ripples spread away from dabbling coot among the spatterdock leaves. Anhingas—the water-turkeys for whom the trail is named—swam submerged with only their snaky necks above water. Overhead, three wood ibis, America's only member of the stork family, soared in wide curves, losing altitude slowly as they descended to roost for the night. Resplendent in metallic hues, purple gallinules stalked across the lily pads. And in the shallows,

white American egrets fished for blunt-nosed gar, producing circles of expanding ripples on the tinted water at every thrust of their spear-like bills. Here and there, scattered on islands just above the water line, stretched the black, beached "logs" that surprises visitors by turning into alligators. Even that most shy of all southern swamp birds, the limpkin, wandered close beside the boardwalk. Fortunate visitors here sometimes have seen baby limpkins trailing along behind their parents on their earliest snail-hunting expeditions.

Park officials have wisely ruled against feeding the wildlife along the Anhinga Trail. The creatures you watch there are not panhandlers congregating to beg for unnatural food. Each is following its own hereditary pattern of behavior, engaging in the activity that has characterized its kind for thousands of years. Here you see the Everglades unchanged.

Only one element has been altered. The creatures have learned—with that almost pathetic swiftness with which they discover such things when given a chance—that here they need have no fear of man. They have lost much of their timidity and secretiveness. The consequence is something almost magical. The visitor has the impression of being in the very heart of a wild world whose inhabitants are unaware of his presence. He seems standing unseen, invisible, amid all the varied life that spawns so richly in the Everglades.

This impression persisted when I returned under different conditions, even under the full glare of the mid-day sun. About the boardwalk a wheel of interrelated life revolves continually. It provides a wildlife show that never ends. Different hours, different days, different seasons reveal new aspects of life. Each visit, even though you return a hundred times, will reward you with

▼ AS SEEN FROM THE END OF THE BOARDWALK: An undisturbed natural habitat, inhabited by an abundant



ir own efforts, just as they did before man came.

fresh sights and new surprises. Looking down, you may suddenly become aware that almost directly below you, only a dozen feet away, an American bittern stands rigid in the swamp vegetation. Or below the wire-mesh sides of the boardwalk, you may see a black water snake looped in the grass sunning itself. Sometimes there is a splash and an uproar among the roosting herons as an alligator lunges toward some victim swimming in the water. Otters have been seen feeding hardly a hundred yards from the trail.

It is during the winter season, at precisely the time when the greatest number of visitors from the North are in Florida, that the Anhinga Trail is most interesting. Then there is the greatest concentration of birds in the slough. During the summer season, when water covers 80 per cent of the Everglades, the snowy egrets and American egrets, the wood ibis and white

features that have lost their fear of man.

Edwin Way Teale



Allan D. Cruickshank from Nat'l Audubon Soc.



S. A. Grimes from Nat'l Audubon Soc.

▲ A Wood Ibis: North America's only stork.

◀ THE ANHINGA, or Water Turkey, after which the Trail is named.

▼ PURPLE GALLINULE, standing on spatterdock or yellow pond lily leaves.

Jack Dermid from Nat'l Audubon Soc.





▼ A GREAT WHITE HERON.

Edwin Way Teale



ibis, the anhingas and bitterns, the little blue and Louisiana herons, tend to spread out. Extending from December 1 to April 30, the winter season is a time of clear weather and comparatively little rainfall.

Long before this dry season of the year ends, nests are already being built by many Everglades birds. On March 1, I counted four anhinga nests already taking shape among the low willows within full view of the trail. At such times, watchers can see, in all its bizarre aspects, the courtship display of the water turkey. During the latter part of the winter, the resident birds at this far southern tip of the United States are already in full breeding plumage.

Along the length of the Ever-

glades boardwalk, a wildlife photographer finds a happy hunting ground unparalleled in my experience. It is the only place I know of where an amateur with simple photographic equipment can, in a fairly short time, procure enough slides or movies to put on an impressive showing for his friends. Blinds are unnecessary; telephoto lenses are not even essential. Almost every step brings some new subject before one's camera. The Anhinga Trail is a roadway to a thousand pictures. Here are creatures unrestrained, untamed, living wild and natural lives, yet moving close at hand and unafraid. The bird that probably has been photographed more than any other here is a certain purple gallinule

▼ A Coot feeding at sunset among the spatterdock.

Edwin Way Teale





Edwin Way Teale

▲ AN AMERICAN BITTERN wading among the swamp vegetation near the Trail.



Allan D. Cruickshank from Nat'l Audubon Soc.

▲ AMERICAN EGRET, a graceful bird with a wingspread of almost five feet.

that poses beautifully as it feeds near the end of the trail. One year this bird appeared simultaneously in four different wildlife lectures illustrated with color movies, and in how many thousands of still photographs it has been recorded, nobody knows.

If any one hour is more interesting than others for visiting the Anhinga Trail it is probably toward the close of day. It is then that the large swamp birds, returning from feeding, come sailing and flapping over the low trees to settle in their roosts for the night. All this wide land of sloughs and sawgrass and mangrove, of ditches and shallow lakes, is heron country. And at sunset they come home, from little snowy egrets and green herons to the wide-winged American egrets and great blues. You see them even after the redness has left the western sky, in silhouette against the glow above the black trees. Strikingly apparent becomes the difference in wingbeat—the slow, plodding stroke of the larger birds, the curious up-flipping stroke of the limpkins. And when all is dark and you are leaving, frogs have begun their braying and

fireflies—although the season is still winter—are flashing among the bushes.

Veteran naturalists and beginners both find fascination in the activity unfolded so close at hand along the Anhinga Trail. The whole cycle of interdependent life, the ecology of the Everglades, is spread out about you. Larger fish can be seen preying on smaller fish and anhingas and herons preying on them. Food chains, predator chains, these can be observed running through the life of the slough. Here the elderly and the young alike may become explorers, for cars can drive up and park at the very entrance to the Anhinga Trail.

First built in 1949, two years after President Truman dedicated the Everglades National Park on December 6, 1947, the Anhinga Trail was rebuilt in 1953. Although I have visited every state in the Union and been in almost all the great national parks, it seems to me that this simple wooden path into Taylor Slough is one of the most interesting and successful features to be found anywhere among our natural wonders. Yet its total cost was only \$2,000!



Asphalt

The ancient

EACH day President Eisenhower, scores of diplomats, and countless foreign and American visitors travel up and down Pennsylvania Avenue. Few of these thousands are probably aware that



British Information Service

▲ A WORKER at Trinidad's Pitch Lake shows the consistency of natural asphalt.

➤ A MODERN ROAD-MAKING MACHINE, laying a five-inch base of asphalt and gravel.



▲ "DEATH TRAP OF THE AGES": A well-known mural by the late Charles R. Knight, depicting the ancient scene at the La Brea pits. (In the Los Angeles County Museum.)

Preservative of the Ages

it to strange uses; modern science is finding increasingly varied applications

By MILDRED C. PERGANDE

the asphalt with which the thoroughfare was originally paved came from the same "lake" that supplied Columbus with pitch to caulk the seams of his ships.

On his third voyage to the New

World, Columbus gave orders to drop anchor off the shores of a tropical island, which he named La Trinidad. Then, before setting sail for more distant lands, he "caulked his galleons and caulked their storm-racked seams with natural waterproofing material." The material of which he wrote in his log in 1498 came from Trinidad's Pitch Lake, as did the asphalt used in paving the streets in many leading cities around the world. Michigan Boulevard in Chicago and the Thames-Victoria Embankment in London are among the famous thoroughfares originally paved with asphalt from Trinidad's Pitch Lake. After four and a half centuries, the lake still produces asphalt.

Another daring adventurer who sighted Trinidad was Sir Walter Raleigh. Stories had been circulating in Spain and England of a fabulously wealthy area called "El Dorado" somewhere in northern South America. Rumors reached Sir

Walter Raleigh in his retreat at Sherborne, and he decided to take command of an expedition. He set out with five vessels and landed about two months later on the island from which asphalt flowed into the sea. We have the description from his notes of the voyage, which were published in England upon his return in order to refute accusations by his enemies at court that he had not even crossed the Atlantic.

Casting anchor at Point Curia-pan on March 22, 1595, he explored the coast in his barge and in time came to a port that was called by the natives Piche and by the Spaniards Tierra de Brea ("Land of Tar"). There he rediscovered the lake of "stone pitch," as he called it, and marveled at the vast quantities of caulking material waiting to be used. He tried it out on his own ships and found it excellent. He pointed out that because it did not melt in the sun like the pitch of Norway, it would be "very prof-





Los Angeles County Museum

◀ **TYPICAL EXCAVATION** at Rancho La Brea showing bones of Pleistocene animals as seen in the Pit Observation Station at Hancock Park, Los Angeles, Calif. The skull of a wolf, hip bones of a large ground sloth, and a mastodon skull are partly exposed here.

itable for ships trading the south parts."

Raleigh was indeed prophetic, for in the years since his visit more than ten million tons of asphalt have been removed from Pitch Lake, and the supply seems well-nigh inexhaustible.

Moderns Still Marvel

The island of Trinidad, 1974 miles from New York, has an area of 1755 square miles. Bitumen, or fossil pitch, can be found throughout its southern part. Point La Brea is, in fact, formed of hardened pitch extending out into the Gulf of Paria. Pitch Lake is located on the highest part of La Brea Point, at Brighton, about 58 miles from Port-of-Spain. Standing on the shore, you see 114 acres of a grayish-black mass spread out before you. The surface of the lake is a series of irregular folds and creases, in which rain water has accumulated.

The asphalt is constantly in motion from the center of the lake toward the edges, in what are called flows or currents. This cen-

ter, which has been measured to a depth of 285 feet but may be deeper, is known as the "Mother of the Lake." The asphalt here is fresh and soft compared to that taken from other parts of the lake. In isolated spots and along the shore line, shrubs and vegetation flourish. Small trees slowly migrate from place to place with the movement of the asphalt. Because their roots and stumps gradually sink into the soft mass, they rarely reach more than eighteen feet in height.

If the soft spots are avoided, it is possible to walk on the lake with no danger of sinking or getting stuck as one would in a quagmire. The soft spots, after exposure, gradually take on the consistency of the other parts of the lake. Along the shore and continuing in a ravine that passes through the village of La Brea and down to the ocean are deposits known as "land asphalt." This is a hard, dry variety of asphalt, which does not flow as does the more liquid substance of the lake. This is most likely the material that Raleigh found as he stepped from his barge. The "land

asphalt" has hardened through centuries of exposure and loss of volatile constituents. Its quality is poor, however, as it contains dirt, sticks, and dead leaves.

On other parts of the island, there are small craters of asphalt that erupt and bubble like the mud geysers of Yellowstone Park. Some of these craters are at the bottom of the Gulf of Paria along the coast from San Fernando to Irois. They occasionally expel quantities of petroleum and lumps or cakes of pitch.

A Petroleum Product

Geologists believe that Pitch Lake has probably been in existence for thousands of years. Petroleum is the "mother substance" from which asphalt is produced, largely by evaporation. In fact, asphalt is obtained as a residue in the distillation or refining of petroleum.

Mining techniques at Pitch Lake are much the same as they were years ago. The crude asphalt, which is usually wet with surface water and filled with cavities created by gas, is dug out with a pick or mattock. The pitch-cutter has five helpers, who pick up the lumps and take them to trucks or small cars run by a cable on a narrow gauge track. These pieces of asphalt weigh from 40 to 100 pounds each; and the men, called "headcrs," balance them easily on their heads. The mining is done in shifts from 3:00 A.M. until noon, to avoid working during the hot tropical afternoons.

If you return to a place where asphalt has been dug the previous day, you find that the surface looks a little rough, but within a week the hole will have filled up com-

pletely. Asphalt melts at, or a little below, the boiling point of water, and it burns with a smoky flame. But at normal temperatures it is a solid, which nevertheless retains enough plasticity to accommodate itself to an uneven surface. If you put a block of the seemingly solid stuff on a coin, it will soon show a sharp imprint. Yet it will break clean if you strike it with a light hammer. It was the viscosity of asphalt, together with its stickiness and excellent waterproofing qualities, that made it popular with the seafaring people of ancient times.

A survey made several years ago showed that the level of the lake in Trinidad had dropped about 20 feet during the past century. However, it is believed that the lake is being constantly replenished by a seepage of oil from permeable beds deep below the surface.

The asphalt taken from Pitch Lake must have the moisture re-

moved before it can be used commercially. The crude asphalt is dumped into large tanks or vats and heated. As it softens and melts, the water boils away. The refined asphalt is then transferred to barrels or drums for shipment.

Deposits of asphalt-impregnated sandstone and limestone, which are usually called "rock asphalt" to distinguish them from the purer deposits of the Trinidad type, occur in many parts of the world, including Switzerland, France, Belgium, Italy, Sicily, Greece, Russia, and Syria. In the United States, rock asphalt is found in Texas, Oklahoma, Alabama, Kentucky, Utah, California, and Oregon. An exceptionally pure asphalt known as gilsonite occurs as vein deposits in eastern Utah and Colorado, where it is mined and used for many purposes where pure bitumen is needed.

In Mexico, asphalt springs occur at points along the Tamesi River and near Chijol, which is 25 miles west of Tampico, and in the Mexican state of Vera Cruz. In 1535, a spring of semiliquid asphalt was discovered in what is now the prov-

ince of Camagüey in Cuba and was used for caulking the hulls of ships. In present-day Cuba, asphalt in quantity is also found in the provinces of Matanzas and Las Villas.

Another so-called "pitch lake" is located in northern Venezuela, only about 105 miles west of the island of Trinidad. This 1100-acre deposit is covered with vegetation, and water stands in pools on its surface. The lake is fed by asphalt bubbling from springs at various points. Its surface hardens as it is exposed to the air, forming a crust up to several feet thick. The asphalt can be dug out in much the same way as at the Trinidad lake.

Prehistoric Animals Trapped

During mining operations at Pitch Lake, bone fragments and fossils are occasionally uncovered. Some years ago, scientists concluded that two bone fragments and a tooth found in the lake had come from a mastodon, prehistoric relative of the elephant. The find helped to plot the distribution of these large animals during the Ice Age.



DIGGING ASPHALT in Trinidad. Mattocks are used to cut out the lumps. The men who are employed in the asphalt-digging rise early but end their day at noon to avoid heat.

Pan American World Airways





▲ BUILDING A GUFU on the Tigris River. The boat is woven of pliant materials and coated outside with asphalt.

► THE FINISHED GUFU ferrying passengers across the Tigris.



Greater quantities of prehistoric remains have been taken from another asphalt lake—the so-called La Brea Tar Pits about eight miles from Los Angeles, California. Mastodons, woolly mammoths, giant sloths, elephants, saber-toothed tigers, cave bears, vultures, and other birds were trapped, as well as botanical specimens such as the trunks of trees and acorns. The theory regarding the La Brea pits is that they were originally formed by blowouts of gas from oil deposits below the surface. The craters then filled with soft asphalt, which in time crusted over. When the heavy beasts stepped onto the apparently firm asphalt surface, they sank into it, and their struggles only caused them to become more deeply engulfed. Their thrashing about may have attracted other animals and vultures to the spot, providing additional victims for

fossil diggers to exhume thousands of years later. The flesh decayed, but the asphalt has preserved the skeletons. Paleontologists have identified the animals as belonging to the recent Ice Age, which reached its peak about 11,000 years ago.*

A Ghost Tree

In February, 1928, a curious event occurred at Pitch Lake. A dead tree suddenly came through the surface of the lake in a perfectly upright position and continued to rise until about six feet of it was exposed. Workmen sawed pieces from the top as specimens, and scientists have concluded from these that the tree may have been

buried in the lake 4000 to 5000 years. The tree continued to rise until it reached a height of ten feet above the lake. For several days it remained stationary; then it started to tilt to one side, and within a month it had disappeared completely.

Anything placed on the surface of the lake will shift its position from day to day. The motion is very slow, but the incident of the tree indicates that the movement is not only on the surface but throughout the entire mass. The movement does not seem to follow any set course.

Asphalt was known to the world long before the discovery of Pitch Lake by Columbus. But experts who have analyzed pitchlike materials used by the ancients advise

*See "The Tar-Pit Tiger," by Edwin H. Colbert in *NATURAL HISTORY Magazine* for December, 1940, and "Tar-Trap Treasure," by Blackmer Humphrey, in the issue for March, 1950.—Ed.



◀ ASPHALT was used between the bricks in the wall of Ishtar Gate in Babylon, built by King Nebuchadnezzar.

us that even in scholarly writings, the word "pitch" has been used loosely for resins that are not asphalt or bitumen. The word "asphalt" is derived from a Greek word which may have had earlier roots in the ancient cultures of Mesopotamia. Prehistoric peoples probably first used the black or brownish-black substance to join together various objects. Its waterproofing qualities seem to have been discovered early. The saga of the hero Ut-napishtim tells how he built a ship in which to escape an approaching flood. "I coated the inside with six gar of asphalt and the outside with three gar of asphalt." This is a forerunner of other flood stories. Some sources contend that Noah also waterproofed his ark with asphalt, when, according

to Genesis VI, 14, the Lord instructed him to pitch it within and without.

Used by Ancient Builders

One of the first recorded uses of asphalt was by the pre-Babylonian inhabitants of the Euphrates Valley in what is now Iraq, in the period between 3800 B.C. and 2500 B.C. The people applied asphalt to carved wooden ornaments, then laid gold foil on them. Archeologists have uncovered floors that were made of a layer of asphalt and clay brick cemented together with asphalt. Royal baths and drains were waterproofed with it. Blocks of asphalt consisting of a mixture of bitumen, loam, and gravel were used to line large sewers that drained the cities. Statues

were overlaid with ivory and mother-of-pearl embedded in asphalt. At the height of Babylonian glory, each successive monarch constructed some important project to perpetuate his reign. Some kings built roads, others erected palaces or built retaining walls on the banks of the Euphrates River. Evidence that asphalt was used in re-enforcing these works has been found. Among other natural sources, the people probably got their asphalt from certain springs known as the Fountains of Is, on a tributary of the Euphrates. Modern scientists know that the ancient historian Herodotus was referring to present-day Hit on the Euphrates when he wrote of a city called Is, and of a river by the same name, from whose source rose many "gouts" (clots) of bitumen. He mentions that this bitumen was used in the wall of Babylon. A bridge 370 feet long across the Euphrates, which archeologists say was built by King Nebuchadnezzar, had piers built of bricks set in bituminous mortar. The base of each pier was covered with a protective coating of asphalt.

The Tower of Babel is said to have been built with asphalt mastic as mortar, and the ark in which the mother of the infant Moses is said to have hid him in the bulrushes also is supposed to have been daubed with pitch. But we cannot be sure of the exact material. It is interesting to observe that in a Mesopotamian counterpart of this story the great King Sargon is said to have been placed as a baby in a casket of rushes by his priestess mother Itti-bel, and asphalt is again mentioned as being used to close the lid. Certainly the people of this area have for many centuries used asphalt for caulking their circular boats called gufas.

(continued on page 51)



▼ A STUDY IN HOT AND COLD. Old Faithful, symbol of the Park, is said never to be lovelier than when the land is snowy.

▲ MIDWAY GEYSER BASIN, as seen by Sno-mobilers who have come from West Yellowstone, the western entrance to the park and the home of the Sno-mobiler.



SNO-MOBILING *through* **Yellowstone**

If you want to see the famous wonderland without crowds, visit it in winter

By JOSEF MUENCH





▲ WINTER VISITORS find the animals unusually friendly, and many photographic opportunities entice the camera fan.



▲ CASTLE GEYSER keeps its cone bare for the few visitors who venture into the Park when it is blanketed in snow.

▼ FIREHOLE RIVER CANYON in the grip of winter: an unfamiliar view of one of Yellowstone's lively little rivers.





▲ THEY LIVE about six animals to the acre and move about under the snow all winter.

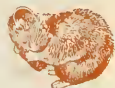


Haymaker of the HIGH SPOTS

The pika's cry seems to come from nowhere, and he moves his hay with the weather

By WILL BARKER

Illustrations by BOB HINES



AUDUBON once received a letter from Thomas Nuttall about the pika, or cony, a tiny mammal of the mountainous regions of western North America. "I first discovered it by its peculiar cry," wrote Nuttall, "far up in the mountain of a dividing ridge between the waters of the Columbia and Colorado, and the Missouri, hiding among loose piles of rocks. From this retreat I heard a slender but very distinct bleat, like that of a young kid or goat. But in vain I

tried to discover any large animal around me. At length I may almost literally say, the mountain brought forth nothing much larger than a mouse, as I discovered that this little animal was the real author of this unexpected note."

All who marvel at the skill of a ventriloquist would be taken with the pika's seeming ability to throw its voice. Its cry is a high-pitched *Ka-ack!*, and it is often repeated as many as twenty times at two-second intervals. First it seems to

come from one spot in the tumbled masses of a rock slide, then from another. But if you are patient, you will eventually spy the crier, perched on top of a broken granite boulder and appearing very much like a dwarf guinea pig.

The pika's short, broad ears are circled by white. Its chunky, seven-ounce body is covered with dense, soft fur of buff or gray. Its shoe-button eyes are black as jet. If you watch closely as the pika utters each cry, you will see that its body

jerks forward and upward and that its ears twitch.

The pika lives in colonies of about six animals to an acre and is well equipped to get over its rough and rugged terrain. The soles of its feet are almost entirely covered by fur except for naked pads near the toe-ends, which afford traction and enable it to leap from rock to rock without losing its footing. Such leaps often save the pika from a weasel, one of its most relentless enemies. Others that prey upon it include martens, eagles, hawks, and owls.

The pika is best known for its haymaking. Instead of migrating to more productive realms or sleeping through the lean months, it gathers great quantities of vegetable material and cures it in the sun. You will see it busy on its haymaking expeditions during late summer and early fall. It generally goes out in the early morning or late afternoon and may travel several hundred feet from its home to harvest its supplies. It collects many varieties of plants, cutting off short lengths of such herbs as the gentian, the saxifrage, and the yarrow. It even climbs into the lower branches of bushes or trees—aspen, elder, and chokecherry—and nips off twigs and leaves with its rather long chisel-like incisors.

Carrying the cuttings crosswise in its mouth, this diminutive relative of the rabbit builds a haystack, always placing it so that the sun can cure the vegetation. The stack is usually in the lee of some sort of shelter, a fallen tree or lichen-covered rock. The animal cuts only

enough forage each day to make one layer, and the stack is the sole property of the pika that builds it. Stacks often contain as much as a bushel, and as many as 34 varieties of plants have been counted in them. Thistles must be a favorite food; most haystacks contain some.

Pikas watch their haystacks well, as two biologists discovered. The men were spending the night above timber line in the Salmon River Mountains. Shortly after sundown, a terrific wind and rain storm came up. All during the night, the two men heard the cries of pikas, as the rain changed to hail and sleet, then to snow. In the morning, there was not a haystack in sight. All had been dragged to safety.

Although the pika is industrious, it stops work for several hours each day around noon to take its ease dozing on a sloping rock. You may not notice it there, for it assumes a bunched-up position and looks rather like a large furry Easter egg. When it awakens, watch to see it wash its face cat-fashion before resuming its work.

The choice of a sloping rock for its noontime nap has earned the pika the name Rock Rabbit. It is also known as the Calling or Whistling Hare, Little Chief Hare, and Tailless Hare. Miners call it the Starved Rat, for it never becomes really fat. Another name in general use in western North America is Cony, which is more applica-

ble to the Syrian and African hyrax, a hoofed mammal of rock-dwelling habits that resembles an earless rabbit. The "family name" of the pika is *Ochotona*, Latin for "small, short-eared rabbit without a tail." Species of pikas closely resembling ours live in the Himalayas and Urals, and the name "pika" comes from the language of the Tungus tribe in northeastern Siberia.

Although pikas were first discovered on this continent as long ago as 1828 in the Canadian Rockies, not much is known about them scientifically. Probably no one has made a year-round field study of their habits and behavior, largely because they live at inclement altitudes varying from 8,000 to 14,000 feet. Three or four young are born in any month from late May to early September. The little animals weigh about an ounce at birth and are weaned early. When about one-fourth grown, they subsist entirely on vegetable matter.

Pikas are active beneath the snow all winter. The naturalist Olaus Murie was driving a dog team one winter up the Toklat River in the Alaska Range. As he passed a tall bluff, he heard the *Ka-ack!* of the pika coming from within the deep snow blanketing the bank. His passing sledge excited the snowbound pikas, and he heard the same wailing cry that Nuttall described as so bewildering to his friend Audubon.

► DILIGENT though he is, he lets the sun do his work during siesta time.





My Animal Concert

By CARROLL VAN COURT

When "The Bird Song" echoed among the vaulting redwoods, the world of nature came alive

IT was to be a fine summer vacation, among the big northern California redwood trees; and I had been promised it, on condition that I practice my music while away. So I packed my things, and in my suitcase I also put my flute and music rack, with some books of exercises and operas I was learning to play.

The place where I was going was called Camp Vacation, a lovely little resort on the Russian River, between Guerneville and Monte Rio, about 75 miles north of San Francisco. Across the river from our camp, about a mile away, was the famous Bohemian Grove, meeting place of that long-famous organization, the Bohemian Club of San Francisco.

One morning, I decided to practice my music in the Grove, early, before the crowd of vacationers began to wander through the place. I had rented a rowboat for several weeks, so I rowed across the river to the Grove, tied my boat to a tree, and went in.

In the center of the Grove, there is a circle of seats, all carved out of huge redwood logs, making it an ideal place for big bonfires, speeches, and the clever dramas they staged in the open air.

What a beautiful setting — ferns fifteen feet high, enormous redwood trees, the redolent smell of the woods, charming greenery all around me. I sat down on one of the log seats and let my imagination recall the pictures of past meetings in the famous Grove and some of the

celebrities who had attended them.

I could see William Jennings Bryan, Senator Phelan, Admiral Dewey, Major General Leonard Wood, President Hoover, three San Francisco Mayors — Rolph, Latham, Robinson—, the famous novelist Gertrude Atherton (only woman member, I believe, of the Bohemian Club), Upton Sinclair, Jack London, George Sterling, and many others.

Time to practice. I set up my music rack, put a piece of music on it, and began to warm up, first with a few difficult scales. In about ten minutes, a couple of blue jays flew down from somewhere and perched on the lower limb of a near-by tree, chattering in answer to my flute notes and acting puzzled, because they could hear the birdlike tones coming from me but could see no birds, anywhere, making the sounds.

They cocked their heads, this way and that, but could not understand it. I had to laugh at their excited antics.

Then, in another tree, a big brown bird started chirping along with me and the jays.

I heard a rustle a few feet away, and the beautiful head of a startled fawn appeared, with its large eyes, listening as if hypnotized. I sat still, and the fawn stayed, to enjoy the free concert.

On a log, near the ground, a tiny chipmunk ran out, sat up, and watched me, evidently with approval, for the little fellow decided to stick it out as long as I did.

Right over my head, from the tree above, a spider let herself down to within a few feet of me and hung there. She was fascinated by the vibrations, as a European spider is said to have been by the violin of one of the composers who practiced for her pleasure.

Then some insects landed on my music and clung to the page, with evident pleasure.

By this time, the trees had many birds joining in with me, in Nature's Concert, all singing like mad.

I was enjoying my amazing and novel rehearsal as much as they were. And the piece I was studying — "The Bird Song" from "Pagliacci" — was very appropriate.

Then, a group of five early hikers, hearing my instrument, strolled into the log circle.

I stopped for only a couple of seconds, pointed to the trees around me, and said one word, "Listen." I put my finger on my lips to ask for silence. Then I resumed my practice.

They caught on to the idea, slid quietly onto a log seat, and sat marveling at my Animal Concert, as I did.

When I had finished my practice, the birds chirped plaintively at me a few times, as if in complaint because I had ceased; and as I folded my rack like the Arabs and silently stole away, I thought I had never played before a more appreciative audience in my life, or one so delightfully unusual!

Meanwhile, rockets were being designed specifically for research. The first of these, the "Private A," was an 8-foot, 500-pound vehicle, which developed a thrust of 1,000 pounds. It was flown, in 1944, to an altitude of 11 miles.

The "WAC Corporal," developed for Army Ordnance by Jet Propulsion Laboratories at the California Institute of Technology, was flown the following year. It soared some 44 miles above White Sands, N.M., carrying 25 pounds of instrumentation. Later, a two-stage bumper configuration—using a V-2 as the initial stage—ascended 200 miles higher, into the exosphere. In 1955, the Acrojet "Aerobee" rocket, with 195 pounds of Air Force instrumentation, reached an altitude of 123 miles.

In addition, a number of small rockets, using a solid propellant, were employed in upper air explorations by the State University of Iowa and the Naval Research Laboratory. Called "Rockoons" because they are launched at considerable height from balloons, these rockets have been highly practical within their inherent performance limits. Being easy to handle and relatively low in cost, Rockoons are used in quantity.

The Martin Viking was developed for more specialized work, with particular reference to the ionosphere—involving greater instrumentation loads as well as much higher altitudes. This rocket is 45 feet in length—and has a base diameter of four feet. The gross weight is about $7\frac{1}{2}$ tons. Propelled by an engine developing 21,000 pounds of thrust, it attains a top speed of nearly 4,000 miles per hour.

Two of the Viking rockets fired between 1949 and 1953 reached altitudes well over 130 miles, carrying between them more than a ton of instrumentation. In May, 1954, Viking No. 11 broke the record for single-stage rockets by attaining a height of 158 miles.

Many important questions re-

main unanswered concerning the upper atmosphere and its varied functions in screening and processing the rays of the sun.

The internal temperature of the sun is nearly 20 million degrees F. This great heat converts hydrogen into helium, in a reaction changing 4 million tons of matter per second into energy that is radiated into space.

What happens to the solar energy that reaches the vicinity of the earth but does not penetrate the atmosphere? What effect does this energy absorption have upon the earth's affairs—upon the soils and waters and air, as well as upon the flora and the fauna of our world?

Among the more immediate approaches to such knowledge is the precise determination of the sun's spectrum in the short-wavelength region and direct study of the ionosphere—the composition of the air and its state of ionization, dissociation, and excitation.

In addition, the various particles that impinge on the upper air from outer space need to be studied at first hand. Among such particles, special interest attaches to those identified with the low-energy end of the cosmic ray spectrum and to the charged particles that are responsible for auroral activity.

Cosmic Rays

The ionosphere represents a research laboratory of virtually infinite extent—one containing an inexhaustible supply of nuclear particles for study and evaluation by the scientist. Cosmic rays contain protons, alpha particles, and nuclei of the heavier atoms. Their intensities and certain of their general characteristics have been established; but their source, since they appear to come from all outward directions, remains undetermined.

The intensity of these rays appears to be fairly constant, above the mesosphere, where a uniform bombardment takes place. Below this level, multiple collisions with air particles produce secondary




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radiations, new meson particles being created and subsequently electrons and gamma rays. The tremendous energy of the primary rays is dissipated in the process.

The charged particles constituting the cosmic rays are deflected by the earth's magnetic field as they approach from interplanetary space. At any given magnetic latitude, only those particles of sufficient magnetic rigidity can reach the top of the atmosphere; all others are deflected away. The minimum magnetic rigidity for penetration to the top of the atmosphere increases from zero at the poles to roughly 60 billion volts at the geomagnetic equator.

Auroras and Airglow

No completely satisfactory explanation has yet been found for the familiar auroras—the Northern and Southern Lights to be seen in the night skies at latitudes near the poles. It is believed that the auroras are caused by streams of charged particles interrupted by the atmosphere on their journey from the sun. This is borne out by high-velocity protons that have been observed by the spectroscope in these displays.

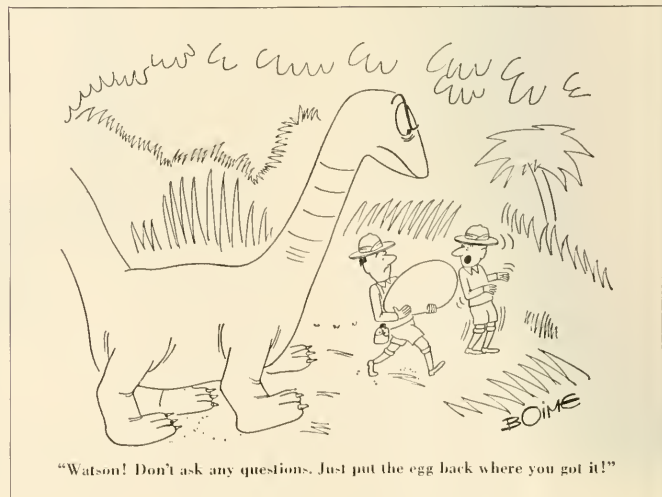
Still another item requiring closer study at high altitudes, is the phenomenon of airglow, an emission by

the molecules in the upper air. Airglow is associated with the various photo-chemical processes going on at high altitude. The intensity, at night, sometimes amounts to five times that of starlight. The precise altitude at which the various wavelengths in this glow appear are as yet undetermined.

International Geophysical Year

Rocketry and atmospheric research will be brought into sharp focus during the period from July, 1957, to December, 1958, which has been designated as the "International Geophysical Year," abbreviated IGY. A concerted effort will be made at that time, by teams of scientists from 40 nations, to conduct important new upper air research, along with numerous other geophysical studies.

An even more spectacular indication of mounting interest and activity in this field came last summer in the President's announcement of plans to develop an earth satellite. An orbital "platform" of this nature will be capable of sustained observations from a position of 200 or more miles aloft, at the threshold of the exosphere. Such satellites will be used for IGY studies. They, too, will contribute to our ever-growing knowledge of our atmosphere.



An Australian "Sea Serpent"

The rare oarfish is
the monster responsible for
some of the legends

By JOYCE BURNS GLEN



Joyce Burns Glen

▲ IT TOOK FIVE GIRLS to hold this 12-foot oarfish, which was washed up on a beach near Sydney, Australia.

TWELVE feet of sea monster was washed ashore on the coast of New South Wales recently. It was the rare oarfish, or ribbonfish, a long narrow creature that weaves its way through the water with an undulating movement like a ribbon. The body of this specimen was about a foot wide from top to bottom but only two inches thick.

The oarfish is covered with a delicate silvery skin, as if painted

all over, and is studded with body tubercles. It has a red crest of slender spines running from head to tail. Unfortunately the conspicuous portion of this crest on the head cannot be seen on this specimen. Curious oar-shaped appendages hang from the underside of the oarfish and give it its name.

Although oarfish are edible, the flesh is soft and rather jellylike.

These fish live in the ocean

depths and are washed up on beaches occasionally after heavy storms. None had been seen in Australian waters since 1947 until several specimens appeared recently off the eastern coast.

This strange deep-sea denizen is so rare that very little is known of its habits or life history. Much longer specimens than this one are known. Exaggerated accounts have no doubt led to some of the legends of the sea serpent.

ASPHALT-PRESERVATIVE OF THE AGES continued from page 43

Great chunks of asphalt apparently floated up from the bottom of the Dead Sea in Biblical times, and this largest of Palestinian lakes was even called Lake Asphaltities by the ancient Greeks and Romans. They used the material that could be picked up on the shore to tar their galleys. Modern scientists know that the presence of asphalt may indicate oil resources, and six companies are said to have obtained drilling rights in this region.

Until recent times, it was supposed that asphalt was used by the

ancient Egyptians in mummification. Early writers such as Strabo (about A.D. 24) and Diodorus (about A.D. 50) stated that bitumen from the Dead Sea was used by the Egyptians for embalming, but chemical analysis of available material by such experts as Alfred Lucas and the Dutch chemist R. J. Forbes indicates that asphalt was rarely if ever used in mummification before 1000 B.C., except perhaps to coat the cloth wrappings that protected the bodies.

During earlier times, however,

asphalt was employed to preserve objects buried with a mummy. In the tomb of the boy Pharaoh Tutankhamen, who ruled Egypt about 1355 B.C., many articles such as chests and couches were preserved with asphalt. Wooden cases containing fowl for the funerary meat were found intact after having been coated with asphalt. After a mummy was prepared, a liquid or semiliquid resinous material was poured over it, and also over the coffin and the viscera, which had been put into a jar. Asphalt, being

cheaper than balsam and resin, may have been used more widely in the less elegant burials.

In the twelfth century, the word *mumiya* came to be applied to an ointment made from scrapings obtained from mummy linen and from material taken from the cavities of embalmed bodies. It was prescribed by a celebrated Arabian physician for the treatment of wounds, and it came to be used for sprains, inflammation, pleurisy, and pneumonia. The supply of mummies was limited, however, and when tomb-robbing became more and more hazardous, the bodies of slaves or criminals who had recently been executed were filled with asphalt and aged artificially in the sun. A French physician, Guy de la Fontaine, who traveled to Egypt in 1564, exposed this gruesome practice, and it was later discontinued.

Petroleum asphalt, which is a

by-product of the petroleum industry, is obtained by the distillation and refining of crude oil. Growth of the automobile traffic after the turn of the century resulted in production of petroleum asphalt in quantity. Within about ten years, domestic petroleum asphalt outstripped natural asphalt imported from Trinidad and Venezuela. In 1954, sales of asphaltic materials from crude petroleum amounted to over 16 million short tons, while lake asphalt imports totaled only 4200 tons.

Both the natural substance and manufactured asphalt have come a long way since the first experimental street paving in the United States in 1870. The Bureau of Mines of the U. S. Department of the Interior lists nine general uses of asphalt. The largest quantity goes into *paving* (roads, sidewalks, and the like). Over four-fifths of all the paved roads in the United States

are surfaced with asphalt. *Roofing* is next, including manufactured asphalt shingles as well as roof coating. Then follow *briquetting*, where asphalt is used to bind coal dust or coke into briquettes for heating and *waterproofing* for tunnels, building foundations, bridges, and boats. The other uses include *molding compounds* for electrical equipment, wiring, and push buttons; *mastic* for laying pavements and floors, or for lining reservoirs and tanks; *pipe coatings* to protect pipes from corrosion; *floor tiles*, and *paints and enamels*.

Surely asphalt can be called the preservative of the ages. The ancients found it practically indispensable in their civilization, and our modern technological advances have put asphalt to a much wider variety of uses. Who knows, perhaps this oldest ally of the mariner and mason may find some use in the space ships of the future.

BOOKS *continued from page 7*

several on the Andes and to one on the forest Indians of the Guianas. This is slender coverage for an entire continent.

Yet when so much is offered, it is almost greedy to demand more. This is a beautiful book which will unquestionably become one of the most popular in the field.

HARRY TSCHOPK, JR.

GROWING PLANTS UNDER ARTIFICIAL LIGHT

----- by Peggie Schulz

M. Barrows and Company, \$3.50
146 pp., 28 illus.

IN the days of our grandmothers, growing plants in the house was a relatively simple matter, but the variety of plant life that could be house-broken was very restricted. Usually the thriftiest collections to be seen were found in kitchen windows, where the warmth and humidity from vapors arising from the stove were conducive to growth. In the darker living rooms and stair wells, the cast iron *Aspidistra* survived, but with no great enthusiasm.

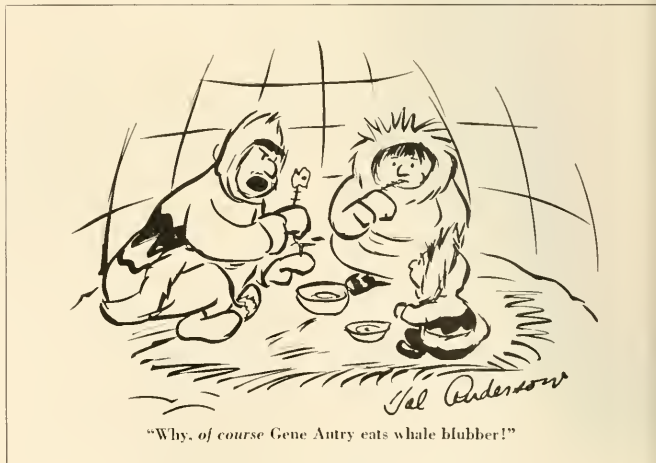
Today, how changed are conditions under which plants may be cultivated indoors. The home grower now has available efficient light sources, equipment for housing the plants so they receive the desired humidity and ventilation, a lit-

erature that describes a wide variety of house plants and the growth conditions they require, and convenient market sources to draw upon for material.

No doubt the most important factors in improved home culture of plants are the modern advance in knowledge regarding the plants' use of light and the availability of light sources and fixtures, which are easy to install in homes and

not extravagant to maintain. Today, plants are grown to healthy maturity not only in windows, but in attics, in dark basements, and wherever one may take the notion. They are grown under these conditions not only in small numbers for personal satisfaction, but in quantities sufficient for sale.

Growing Plants Under Artificial Light tells, in simple language, just how to go



about taking advantage of these improved facilities. The sketches and halftones supplement admirably the fundamental data so ably set forth. It is very helpful also to have a list of dealers and suppliers with their addresses.

This book is a "must" for anyone contemplating the adventure into houseplant culture, and it will be useful even to those who have already got their feet wet in such an adventure.

HAROLD E. ANTHONY

AMERICAN MEN OF SCIENCE, Vol. II

----- Edited by Jaques Cattell

R. R. Bowker and the Science Press
\$20.00, 1276 pp.

THE ninth edition of *American Men of Science*, Vol. II, gives biographical facts on 25,000 American and Canadian biologists. Vol. I, which appeared last year, covered the physical sciences. Vol. III, which is scheduled for publication in the summer of 1956, will include the social sciences.

The growth of these volumes is a commentary on the rapid expansion of science. The ninth edition shows a 50 per cent gain over the eighth, published seven years ago, in the number of physicists and biologists considered eligible for inclusion in a work of this sort. The social scientists have not been included before. The three volumes will contain over 90,000 biographies.—Ed.

CALIFORNIA GRIZZLY

----- by Tracy I. Storer
and Lloyd P. Tevis, Jr.

University of California Press, \$7.50
335 pp., 36 illustrations.

THIS is a substantial documentation of the history of the Golden State's impressive though now extinct wild animal, the California grizzly bear. It attained a size ranking it with the world's largest carnivorous mammals. Before the white man reached California, this big bear existed in substantial numbers, had little to fear from the Indians, and was the dominant element in the wildlife of the primitive environment. Today there are no California grizzlies alive and only a very few specimens in the museums of the world. This book brings together a great store of factual data, a vast amount of anecdote, folklore, and hearsay to provide what will undoubtedly be the standard reference and authority for years to come.

Such a powerful and conspicuous animal would be certain to make an impression on the human inhabitants of California, and we find the bear on the Great Seal of California and its presence re-

flected in many place names. It is surprising that so little importance was attached to recording its life history and accumulating museum material that today the animal has dropped out of sight and most of our knowledge is casual and fragmentary.

It is a sad commentary that so many of the anecdotes tell of how the bears were killed, captured, or pitted against bulls in an arena. The bear was too dangerous to be compatible with modern man's occupation of California, but something short of extermination should have been possible. Under certain circumstances this huge bear became tame and friendly, and some of the most interesting pages of this book tell of the surprising experiences of Grizzly Adams and his various pet grizzlies.

Both text and illustrations are interesting and the reader gains not only an insight into the part played by the bear, but also quite a glimpse of the adventurous and rugged circumstances of California's early days.

HAROLD E. ANTHONY

MAMMALS OF THE WORLD

----- by Francois Bourlière

Alfred A. Knopf, \$12.50
223 pp., 245 illus.

THIS book of many handsome illustrations, both black and white and in color, carries a text that introduces the mammals as elements of a particular environment and tells how they live. The author emphasizes the ecological aspect in an interesting and educational fashion. The animals are not described for purposes of identification. Instead the reader will encounter descriptive passages of the major environments in which the mammals live, the principal factors of climate, topography, and vegetative cover that condition the very existence of the mammals.

Mammals have been popular subjects for pictorial expression from the very beginnings of man's recorded history. The end papers of this book show the ancient cave paintings and reveal that the primitive artist was not "doodling" for his own amusement but brought out form and action in startling realism. Modern photography now provides a more effective and dramatic vehicle for educating the public than has ever been hitherto available.

Bourlière divides the world into six major categories, tropical forests, deserts, temperate forests, the great north, the mountains and the water. The reader will note the great variety and adaptability of mammal life. If there is a potential livelihood for a mammal, on or under the surface of the earth, in the trees, in the air, or in the water, some mammal will be discovered living there.

Today many of these creatures are highly specialized, particularly tailored to fit the circumstances, one might say. But this has not always been the case, for what we see today is the end result of a long evolutionary prelude.

This reviewer must take exception to the statement that armadillos are terrestrial vegetarians (they are principally insectivorous or omnivorous at most) and that wolves still exist in small numbers in New York State. The last wolf known to be a native New Yorker was killed before the turn of the century.

HAROLD E. ANTHONY

SPIDER, EGG, AND MICROCOSM

----- by Eugene Kinkead

Alfred A. Knopf, \$4.00
243 pp.

THIS book gives profiles of three remarkable men who have devoted much of their lives to and still continue to find reward in the intensive study of seemingly small things. All are biologists of great imagination who have left more or less deep marks on their fields of science.

Dr. Alexander Petrunkevitch, Professor



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Emeritus of Zoology at Yale University, at 79 years still champions the spider in active fashion. The dean of American arachnologists, he has contributed voluminously to the world literature on arachnid morphology and evolution. Noted as a writer, linguist, nature photographer, and philosopher, Petrunkevitch has been, above all, a remarkable teacher, whose magnetism still attracts a large circle of admirers.

To Dr. Alexis Romanoff, who at 63 is Professor of Chemical Embryology at Cornell University, the egg is all. A quiet man, he lets his splendid publications speak for themselves, and they speak loudly in terms of gain to the poultry industry and

consumers of eggs. In this book we learn a lot about eggs and the innumerable ramifications of a seemingly simple subject.

Dr. Roman Vishniac of New York City, commercial photographer and microbiologist, is preoccupied with the Protozoa and sees beauty in small things. His contribution is an amazing series of remarkable photographs, many taken under seemingly impossible circumstances. His picture philosophy is a simple one: "The photographer must not think like a man. He must think like a bug."

Each of these verbal portraits is a separate unit and appeared earlier nearly in its present form in the *New Yorker*

magazine. In such a short space the author-reporter has necessarily painted sketch biographies against the background of more or less light excursions into the field of each biologist. The book gains unity from an interesting introduction by E. B. White who hails the dedication of such men "whose feeling for their subject is so intense that their professional life is one long love affair."

Unfortunately, there are factual errors, and the reader will perhaps regret the lack of photographs of the men and their workshops. Further, it would be necessary to go to their original works to form a comprehensive impression of the scope of their studies. WILLIS J. GERTSCH

LETTERS continued from page 4

Cat Comments

SMS:

I would like to congratulate you on your superb article on cats in the November issue of *NATURAL HISTORY*. As a collector of cat pictures, I would very much like to have a copy of the portrait of a Red Tabby. It is just wonderful, I want to frame it. . .

(MRS.) VICTORIA BROWN

Shippan Point, Conn.

Enlargements are unfortunately unavailable.—Ed.

SMS:

As a lover of animals in general and particularly of our friends, the dogs and cats, I protest the vicious anti-cat article that appeared in the November issue of your magazine.

Luckily, I had a chance to see this article before buying a copy of this otherwise attractive publication. I think the sly aspersions on cats, in the guise of featuring them, have cost you several sales, and that this loss will grow in the future.

We cat-lovers enjoy cat pictures, and find factual articles on them interesting; but why such an obviously biased writer as this Gary Webster?

There is no objection to his being informative by recounting historical incidents, though he could have found a greater proportion of ones in which cats were truly loved and honored. True, he mentions the ancient Egyptians, but his sympathies appear to lie with their enemies.

The objection is to his opinionated editorial conclusions on the nature of the cat. He repeats the old slanders of the cat-haters as fact. It is true that cats are not servile. Many persons are irritated by this, but the demand for servility is no tribute to the nature of such persons.


The true cat-lover is not looking for something to boss, but something to love which will love him in return. The affectionate and devoted response of cats that are truly loved is something that Mr.

Webster and his ilk have not experienced. I do not say *could* not experience, for I have known people who in their later years found to their surprise that a cat's nature is entirely different from what they had

supposed. Of course, every cat is an individual, and has his own unique personality—just as is the case among humans. But I have never known any cat that could not truly love and serve (I use the word



▲ DOG AND SNAKE. A remarkable photograph by Henry B. Kane.



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"serve" deliberately) a human of kindness and understanding (not bossiness) if given a fair chance.

We of my family are blessed in that we have known what it is to merit and enjoy the companionship, love, and *loyalty* of cats.

BREVARD STEPHENSON
Pittsburgh, Penna.

Tree Champions

SIRS:

A friend loaned me a copy of the May issue of *NATURAL HISTORY*, and I found much interest in "Whistler in Boots." However, in the article entitled "Big Cypress Swamp," the claim that Florida and Tennessee have the largest trees east of the Rockies is an error. In McCurtain

County in southeastern Oklahoma there is a Bald Cypress that is slightly more than 14 feet in diameter. The tree grows on Muddy Boggy Creek, on land that is flooded only when the creek overflows. The tree is not fluted any more than an elm or an oak. At 30 feet, it has a diameter of 10 or 12 feet. The location is between the burg of Eagletown and the town of Broken Bow. The tree has gained only four inches in diameter in 60 years.

DAVID J. EDWARDS

Calvin, Okla.

The following information is offered by James B. Craig, Editor of *American Forests*, the publication of the American Forestry Association which for some time has been considered the clearing house for tree championships:

According to our up-to-date figures on big tree champions, "The Senator" Bald Cypress in Florida has been dethroned by a new champion of the same species, but its location is the Middle Fork of the Obion River in Weakley County in northwestern Tennessee, rather than in Oklahoma. The new champion has a circumference of 39 feet, 8 inches and a height of 122 feet, six inches.

These Champions, of course, are always being dethroned, which is the purpose of the contest, namely to get the biggest trees of various species.

Safety for the Giant

SIRS:

Dr. Harold N. Cole, who expressed concern over the safety of the giant cypress at Longwood, Florida, will be glad to know that there is a large metal fence around it. I visit the spot frequently and know that Mrs. Hughes, who lives on the grounds, is a good "caretaker." She would tolerate no vandalism if it were within her power to stop it.

Incidentally, there are a few other notable trees in the area, which do not attract as much attention as the giant because they are somewhat off the beaten track.

ARTHUR D. BATES

Summerfield, Fla.

SIRS:

Please accept my congratulations on Miss Weaver's excellent article about the Indian, Sequoyia, in *NATURAL HISTORY*.

LUDWIG K. MOOREHEAD
New York, N. Y.

NOTICE — Readers are encouraged to submit their own photographs of natural history subjects. Those selected for publication on these pages will be paid for at \$5.00 each, with full credit to the photographer. Return postage must be included.

▲ HORNE TOAD, thumbnail edition. "Though horned toads are associated with hot, dry regions," writes W. C. Vanderwerth, who took this picture, "they seem to like the coolness of watered gardens and lawns. This alert little fellow was found in a garden in Norman, Okla., along with four others, presumably from the same lot of eggs."

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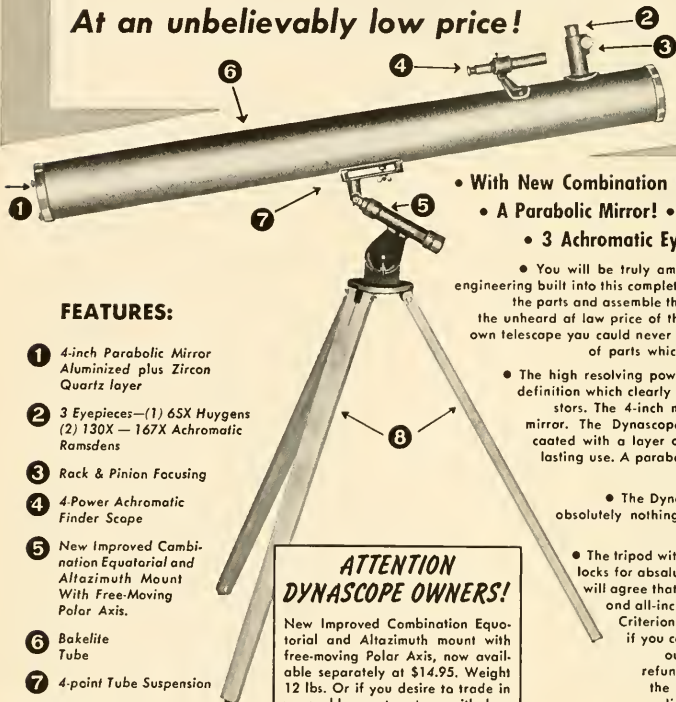
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25. FRANCK: Symphony in D minor; Netherlands Phil. Orch.; Goehr, cond.
26. STRAVINSKY: Firebird and Piano Concerto; Netherlands Phil. Orch.; Mewton-Wood, piano; Goehr, cond.
27. SCHUBERT: Symph. No. 3; and Fantasy and Rondo for Piano and Trch.; Hupperts, cond.; F. Pelleg, piano.
28. PROKOFIEFF: Violin Concerto No. 1; R. Odnoposoff, violin; Holtreiser, cond. Piano Concerto No. 1; Richter, piano; Kenderashin, cond.
29. MENDELSSOHN: "Scottish" Symphony; Netherlands Phil.; W. Goehr, cond.
30. DVORAK: "American" Quartet; Pascal Quart. Carnival Overture; Orch. Vienna Op.; Swoboda, cond.

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NATURAL HISTORY

The Magazine of the American Museum of Natural History

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February, 1956 Volume LXV, No. 2

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From a color transparency by Nelson S. Knaggs

Your New Books 61

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THE COVER THIS MONTH

This Indian is a Chamula of Mexico's southernmost state, Chiapas. The unusual shoes he wears are the same as are known to have been used more than 1000 years ago by the Mayas. Similar styles can be seen on many of the figures carved on Maya stones dating from the Late Classic Period (about the seventh to the ninth century.)

The Chamulas have preserved much of their cultural vigor despite European influence during recent centuries and are one of the most colorful groups of Middle America. There are approximately 26,000 of them, living scattered among the forested mountains of Chiapas. Though the state of Chiapas includes some of the ancient Mayan lands, it actually faces the Pacific Ocean rather than the Atlantic. Its highest mountain, Cerro Zontehuitz, is about 9,400 feet high. In area, it is slightly larger than West Virginia, and as many as 200,000 Indians may live within its borders.

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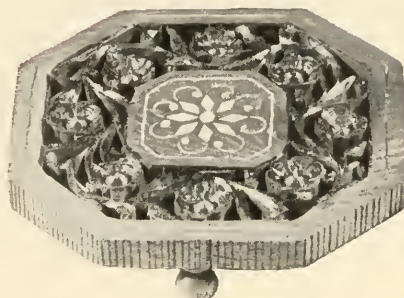
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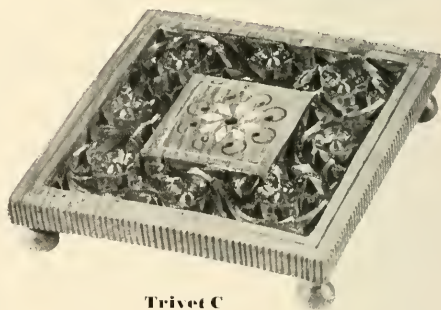
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PRIMITIVE ART

----- by Franz Boas

Dover Publications, Inc., \$1.95
372 pp., 308 figs., 15 plates.

----- by Erwin O. Christensen

Thomas Y. Crowell Company, \$15.00
348 pp., 348 Black and white illus.,
32 color plates.

IN 1927, when Franz Boas' brilliant pioneer study first appeared, primitive art was known and appreciated chiefly by a small minority of artistically-minded intellectuals who admired it in part because it was so far removed from classical tradition. To the average person of the Twenties, however, primitive art was strange and ungainly, frequently indecent, and often downright ugly.

Today most fine arts museums of any pretensions have staged highly successful showings of the artistic productions of primitive people from Africa, ancient Peru, the Pacific islands, or Stone Age Europe. There are probably as many avid collectors bidding for the carvings of Gabon and Bahruba "savages" as for the canvasses of Gauguin and Braque.

Primitive art has arrived. It is not only respectable; it is fashionable, and very expensive. In spite of all that has been written from various points of view, I suspect that it has arrived chiefly because it has merit and competence, and we today are aware enough to realize it. Whether one understands the symbolic meaning and original function of a mask, a figurine, or a sandpainting, it has striking and interesting form, texture, color, or design. After the wild and often undisciplined experimentation by our own artists in search of something new, it has a dignity and sincerity that is apparent to anyone.

Most primitive art was collected by anthropologists, explorers, and missionaries, which is why the great bulk of it is housed in natural history museums. Only recently has it begun to find its way into museums of art. This accident of history explains the two basically different attitudes toward the material. The anthropologist sees primitive art as a part of culture generally. He is interested in questions of origin, process, stylistic change, and the like. The art historian is concerned chiefly with aesthetics. He is more inter-

ested in the object than in its cultural context.

The present two books, each entitled *Primitive Art*, represent these two divergent points of view both of which are legitimate and valid. Boas, the anthropologist, is scientific, objective, and keenly analytical. Christensen the art historian is subjective and selective, and his text is tinged with the clichés of art criticism. He deals only superficially with the history and provenience of the pieces, since, as an artist, he is interested primarily in the objects themselves.

The books contrast sharply in other ways. Christensen's is a new, deluxe edition, superbly illustrated with black-and-white and color photographs, and with drawings. Boas' is an unassuming paperback reprint, with poorly reproduced photographs and some line drawings that are less than adequate.

Each book has its defects and its merits. Boas' is still the authoritative study of primitive art, even though the illustrations are inadequate and the Indian art of the Pacific Northwest is overemphasized at the expense of other areas. Christensen's is an eye-filling once-over-lightly trip through the entire field of primitive art. For the reader who wants to know what primitive artists were capable of producing, it is a good introduction, provided he realizes that the illustrations are highly selected and that the text is frequently naive.

HARRY TSCHOPIK, JR.

THE WINDWARD ROAD

----- by Archie Carr

Alfred A. Knopf, Inc. \$4.50
282 pp., 17 illus., 3 maps.

IT IS a surprising but incontestable fact that the green turtle had a marked influence on early exploration and activities in the Caribbean area. In this delightful book, Archie Carr goes so far as to say, "All early activity in the New World tropics—exploration, colonization, buccaneering, and even the maneuverings of naval squadrons—was in some way or degree dependent on turtles." The author establishes the validity of this thesis with numerous examples of man's depending on sea turtles for fresh meat while on long voyages before the development of refrigeration. He draws an interesting comparison between the role of the bison in the settling of the western United States

and that of the green turtle in the development of the Caribbean region. The contrasts and similarities between the two animals are interesting to contemplate. Turtles have made an important impact on man in many parts of the world throughout human history. These animals have been Archie Carr's professional obsession, which has proved a boon to the turtles and mankind, as well as to Dr. Carr.

This book is difficult to classify—except to term it non-fiction. It is partly a book about sea turtles, but definitely not a book on turtles. It is partly a travel guide to some out-of-the-way spots in the Caribbean. As such, it is full of local flavor and aroma. Most of all, the book consists of a series of beautifully written, colorful accounts of the author's experiences "prying about in strange places" while seeking knowledge of the sea turtles. It is a fascinating book, filled with interesting anecdotes, as well as engaging biological



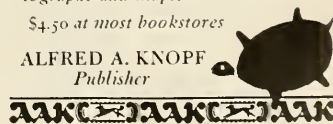
by ARCHIE CARR

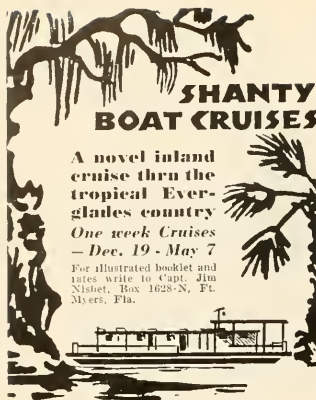
Author of *High Jungles and Low*

A supremely gifted nature writer, Archie Carr, Professor of Biological Sciences, University of Florida, now tells the fascinating story of his search for facts about the habits of the great sea turtles of the Caribbean—a search that reads like a scientific mystery story. It is a book, too, about the amazing people, plants and animals of the islands, a thrilling experience for all nature lovers. *Illustrated with photographs and maps.*

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observations. It is sure to make many readers hope that Archie Carr will continue to pry about and write about his quest for information on turtles.

JAMES A. OLIVER

THE VIKING ROCKET STORY

----- by Milton W. Rosen

Harper and Bros., \$3.75
242 pp., 10 drawings, 47 photos

EVEN if you are not too much interested in rockets, or if you feel that you have read enough about them, *The Viking Rocket Story* is a book not to be missed. Those who are not interested in rockets per se will read with astonishment what a tremendous undertaking a big "shoot" actually is, how many scientific disciplines, engineering activities, organizational bodies and, last but not least, different individuals of different temperaments and inclinations have to mesh to bring about a success. As for those who have read other books on rockets, the answer is furnished by the author in saying that: "the past and, indeed, the future have been treated thoroughly,—it is the present that lacks documentation."

The man who wrote this book was in charge of the Viking Rocket project. Mr. Rosen is also a good writer. He tells not only about the rockets and the trials and tribulations of the men who made them work, but also about the men themselves.

The Viking of the U.S. Navy (originally named Neptune) was the first large liquid fuel rocket built in this country after the Second World War. Like the German V-2, it used ethyl alcohol as its fuel and liquid oxygen as the oxidizer, but in many respects it differed from the V-2. It had a different shape, a different construction, and a different method of stabilization. Naturally every Viking man looked enviously at the high-altitude record established by a V-2 rocket from the White Sands Proving Ground in New Mexico. That altitude record had been 114 miles, and everybody involved in the Project felt that the Viking had to beat that.

But Vikings Nos. 1 and 2 developed a minor flaw when in flight and reached only 50 and 32 miles, respectively. No. 3 had to be "cut off" by radio (meaning that the fuel flow had to be stopped), because there was danger that it might fall outside the Proving Ground. No. 4, fired from shipboard (and one has to read the story to realize how much preparation this needed), climbed to 105 miles, and No. 5 to 108. No. 6 suffered a failure of the fins and made only 40 miles. No. 7 finally succeeded, climbing to 136 miles. No. 9, the first model of a somewhat larger type, achieved the same altitude. So did No. 10, but No. 11, fired May 24, 1951, set a new record: 158 miles.

Some two years from now all these figures will look quite small, because satellite shots to a maximum distance will have been made. But the rocket that will lift the three-stage satellite assembly off the ground will probably be a still more improved Viking. It will exist only because it had improved predecessors, the ones whose story is told in this book.

WILLY LEY.

YANKEE'S PEOPLE AND PLACES

---- by Irving and Electa Johnson
and Lydia Edes

W. W. Norton and Co.
\$5.00, 332 pp., 44 photographs, 3 maps

THIS is just the book for frustrated land-hubbers, explorers, and anyone who ever loved a boat. The remarkable Johnsons emerge from its wind-blown pages as insatiable adventurers, gifted chroniclers, and yachtsmen par excellence as they tell the story of their circumnavigation of the globe under sail, mostly square sails and one 1600-square-foot balloon jib. As five times before, it is a 35,000-mile, 18-month sojourn in their beautiful 96-foot brigantine with a doctor and an amateur crew of 21 girls and young men who must be counted the most fortunate of our citizens.

Odd and fascinating niches of the globe cross the pages as the skipper wanders to the places that he has come to like best in 20 years of seafaring—Zanzibar, Cape Town, Haiti, Bangkok, Singapore, Indonesia, Borneo, New Guinea, the Solomons, Tahiti, Rapa, Pitcairn, the Tuamotus, the Galapagos, to mention a few—places where lonely people await the *Yankee* with a warmth reserved for old friends.

One cannot read this tale of adventure in the South Seas without feeling the great attraction that captured Stevenson and Melville generations before James Michener and Joshua Logan made them into a household dream. Interspersed through the text are beautifully descriptive letters by Lydia Edes to her family, which are filled with the excitement of new adventure, and here and there are reflections, predictions, tips (for example, a cruising guide to the Galapagos complete with map), and assorted facts otherwise hard to come by.

One learns to know the young crewmen, their idiosyncrasies and strong points, and marvels at the job of human relations which the Johnsons face with the bursting young family and the constant barrage of eager Robinson Crusoes who converge for haircuts when they learn that the golden blonde is the ship's barber.

But, alas, unlike Bligh's crew, the expedition finally turns homeward, breasting

the stormy Atlantic. Landfall is finally made off Coney Island, and someone is heard to ask an old question, "What kind of natives live in those funny houses?" The once soft amateurs emerge from the *Yankee* at Gloucester with an appreciation of the world, its people, and particularly the Johnsons which time will never dim.

E. THOMAS GILLIARD

THE JUNGLE IS A WOMAN

----- by Jane Dolinger

Henry Regnery Company, \$3.95
225 pp., 16 photos.

*The jungle is a woman,
She bares her bosom to the rain
And sings her Pagan love-song
Insensible to pain—*

THIS lurid little ditty supplies the title and sets the tone of the latest in Amazonian "exploration"—this time by a woman. It seems that the authoress, formerly a secretary in an airline office in Miami, sees a classified ad reading: "Author needs adventure-loving Girl Friday." She answers it, and in no time flat finds herself headed for the Gran Pajonal, that "tractless," "unexplored" wilderness in eastern Peru, now so familiar to readers of adventure tales.

With her is her author-employer and traveling companion, a Mr. Krippene. He is not just searching for unexplored rivers or rare orchids, or even uranium. He is looking for living, breathing examples of the Java Ape Man, and in Peru, too.

During most of the narrative Pithecanthropus unfortunately gets lost in the shuffle, and instead we are subjected to a routine treatment of piranha fish, snakes, and menacing Indians. The time would seem ripe to work out some system of symbols to deal with these stock hazards of Amazonian travel so that they would not have to be described in detail.

Miss Dolinger (now Mrs. Krippene) is unable to keep the names of the Ucayali tribes straight, and her ethnological observations are about eighty percent inaccurate. We are told, for example, that the Shipibo Indians deform their children's heads so that they can tell them from monkeys, and that the Piros attract butterflies all over their bodies. Perhaps the Shipibos I knew were unusually perceptive, but they had no trouble sorting out the children from the monkeys, and our Piro boatmen were not troubled with butterflies—at least, not externally.

The Java Ape Men, of course, never materialize. Instead, the adventurers finally come upon a band of naked "pre-Stone Age people" (whatever they are) who converse in grunts and eat their food raw. Maybe this is what is called "science fiction"; certainly it is not science.

HARRY TSCHOPIK, JR.

LOUIS AGASSIZ FUERTES:

His Life . . . and Correspondence

----- ed. by Mary Fuertes Boynton

Oxford University Press, \$7.50
317 pp. 1 photo, 16 original drawings,
largely unpublished

WHEN Louis Fuertes was yet in college, Elliott Coues, the leading ornithologist of the day, declared that he gave promise of becoming America's greatest painter of birds, not excepting Audubon himself. And at a memorial service held years later after Fuertes' tragic death in an automobile accident, Frank M. Chapman said: "If the birds of the world had met to select a human being who could best express to mankind the beauty and charm of their forms, their songs, their rhythmic flight . . . , they would unquestionably have chosen Louis Fuertes." These tributes by qualified experts were well founded.

Enthusiastic field observations, almost throughout the world, provided Fuertes with a store of information about birds; he possessed a unique ability to transfer these impressions of the living bird to the canvas. Some artists, including Audubon, excelled Fuertes at producing large finished compositions, but the latter's bird portraits, which adorned many of the leading bird books of the day, are, as a series, unmatched here or abroad.

The enthusiasm, sparkling wit, and whimsy of Louis Fuertes won him a host of friends, and are visible in his extensive correspondence with members of his family and with other artists and naturalists. Abbott Thayer, Frank Chapman, John Burroughs, and many others. His daughter, Mary Fuertes Boynton, wisely decided to use a selection of these letters as the focal point of this biography. The result is a very entertaining and heart-warming book.

DEAN AMADON

ZAMBESI

----- by J. F. Macdonald

St. Martin's Press, \$4.50
240 pp., 12 illus.

THIS is the story of one of the world's great rivers, a river of little significance to the average reader because it has no important shipping and runs for many of its 1700 miles through country uninviting and seldom visited by the tourist. The river is the underlying theme, but the author has much to say of the people who live along its course. This is a thought-provoking book. The interesting historical background and well-written description of topography, environment, and climate provide the setting for a better understanding of the all-important question in Africa today; namely, what is to be the lot of the black man.

Starting at Zambesi headwaters, in An-

continued on page 109

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By JENNIE E. HARRIS



Johns-Manville

▲ MODERN MACHINES have replaced the simple methods used to extract diatomite in the early days of discovery at the Lompoc deposits.

DIATOMS are classified with the algae. Their many shapes are a challenge to the photographer, but his task is no easy one, because a diatom 1/200th of an inch long is well above the average size. They have been divided into two broad divisions, the *Centrales* (or *Centricae*) and the *Pennatae*. The *Centrales* are chiefly found in the sea and usually have a cylindrical and sometimes disclike shape, with radial markings and often with spines. (See first three photographs.) The *Pennatae* (last two photographs) are commonly boat-shaped, with markings arranged on either side of a median line.

◀ LONG SPIRALLY TWISTED CHAINS with a conspicuous number of long hairlike projections characterize this representative of the *Centrales*, *Chaetoceros debilis*.

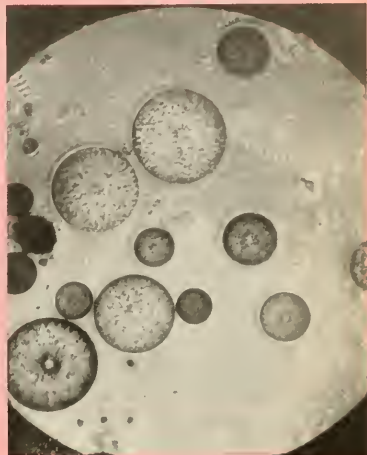
ψ A STRAIGHT CHAINLIKE FORM is exhibited by *Chaetoceros didymus*.

IN the white hills of Lompoc, California, electric shovels are scooping up encasements of plants that lived millions of years ago. Millions of encasements in every million-year-old spoonful. Most of them are microscopic, with the cool look of ice, and often they are as filigreed as flakes of snow. It takes a microscope to see their intricate designs, which become even more intricate under the electron microscope.

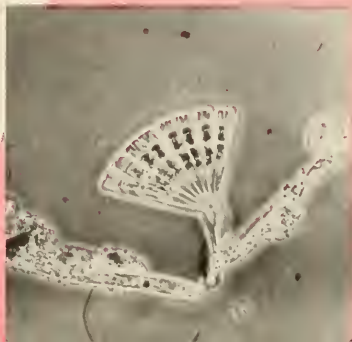
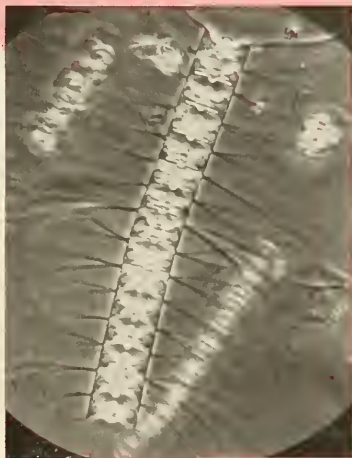
Massed together, these whole and fragmentary shells make the Lompoc hills white. But they are not pressed together. The loose contact between the particles gives the mass porosity, lightness. Only the outer points of rays or spears touch. All stay firm, unyielding, as when they lived some 12 to 28 million years ago in the Miocene period.

It was further back, in the Cretaceous period, that their earliest forms came into being. Perhaps during the early millions of years their evolution was slow. Then in the following era, the Tertiary, when the Alps upheaved and the volcanoes in our Rocky Mountain region rolled quantities of lava over the landscape, this new kind of plant, the diatom, extended its distribution. There were hoards of diatoms on the surface of waters, suspended in layers inside waters, and around rocks and precipices

THESE TWO REPRESENTATIVES of the other broad group of diatoms, the *Pennatae*, are of the genus *Meridion*. They are fresh-water forms and exhibit beautiful fanlike patterns.



▲ THE DISC-SHAPED DIATOMS are represented here by *Coscinodiscus apiculatus*.



Photos by Roman Vishniac



Johns-Manville

▲ THE DIATOMITE WORKINGS at Lompoc. Quantities of overburden must be removed to reach the pure layers.

submerged in water. This plant, this single cell, became one of the most prolific of growing things.

It is still prolific, though the total mass production may now be more moderate than in the Miocene period. Several thousand species of diatoms are known, and they are classed among the algae. Scientists find them in most waters—in the Atlantic and the Pacific, in fresh Alaska rivers where salmon return to spawn, in subtropics near Sargasso, in the antarctic where open-ended bergs gleam brick red or darkly chocolate with their diatom coating.

Diatoms coat logs in streams and ditches. You can dip up diatoms in a spoonful of pond mud. Pluck a cattail from a marsh and you find their slippery accumulations around the stem. Forms of luxuriant diversity inhabit warm waters, but the greatest numbers are found in polar seas. Diatoms abound in the antarctic, making a rich pasturage for

various creatures. Living diatoms are usually golden-brown, but the refraction of light from their intricate sculpturing causes some to appear bright green, rich blue, or red. They can live frozen inside solid blocks of ice, to revive and reproduce when thawed out. They appear to be fragile yet are most hardy, because each builds a shell of silica for skeletal support.

Quartz is silica. So is opal. Silicon ranks second only to oxygen among the earth's most abundant elements. Its oxide, silica, comprises over 58 per cent of the earth's crust. Silica is the coarseness in grass blades that gives your fingers a vicious cut. It is part of the glisten and the sound of the so-called singing sand—harp strings in the sands of Arabia or bell-like ringing in southern California's musical dunes. Sandstone sparkles with silica. Silica is one of the petrifying substances of our gemmed forests.

In sea water, however, silica may

exist as less than one part, or only a few parts, per million. Yet the diatom, the one-celled plant, has power to take silica from water and fashion for itself a crystal box that has defied pressure and dissolution through millions of years.

The box of the diatom is as much a part of it as our skeleton is part of us. There are two halves, one overlapping the other like the two halves of an aspirin tin, but in thousands of shapes and patterns. Surely nowhere else, unless perhaps among living coral, can you find such arrays of lacy beauty. Some eases are like needles of frost, moon crescents, or stars with as many as 20 points. Some are like tiny buttressed fortresses. Some shapes are concave, some convex. Sometimes the crystal-like walls, perhaps only a few millionths of an inch thick, are dotted, arabesqued, girdled—each fairy pattern making a fine display of symmetry or asymmetry. Yet the maker of each jewel box is

a plant, differing from other plants in the way it builds its type of cell wall.

Many forms live attached to a rock or to another plant, but some of them have the power of independent movement. They are not the only plants with movement, but they show certain peculiarities in the way they move. They are fast in comparison with the slow-moving algae known as desmids, for instance, though slow in comparison with microscopic animals such as the unicellular protozoa or the microcrustaceans. Their movement is sometimes described as deliberate, stately, steady. Some of them move forward a short distance, pause, then move back almost the same way they came, sometimes in rhythmic little jerks. How they move may mystify the watcher, for he sees no apparent action. "Cytoplasmic streaming" is one phrase that botanists have used in describing the movements.

If you ask a specialist in diatoms to tell you about some of the exciting mysteries connected with them, he may say: "How did they evolve

into so many and such widely diverse species or form-designs? How does the diatom extract and metabolize silica? Why do diatoms have a preponderance of pigments other than green chlorophyll? In what state do many of them tide over a dormant period, and what is the stimulus that brings them quickly into heavy productivity?" He may admit perplexity about certain aspects of their reproduction. These are only a few of the questions on which specialists are accumulating information.

Reproduction

To reproduce, the strange little plant usually divides into two daughters, one slightly larger than the other. Division in the larger species is apt to occur during the night. Some believe that the cell first increases in size, the growth pushing up the cover of the box. The nucleus divides. Then finally there are two so-called protoplasts, with a duplication of tiny cell organs, one set lying in the cover part of the box, the other in the inner or bottom part. Thereupon each daughter secretes a new half-shell. The daughter that keeps the original cover as a cover builds a new half-shell of normal size that fits inside it. But the lesser daughter, using the original bottom as a top, must build a smaller half-shell to fit inside. Sometimes expansion takes place at the time of division, but when not, one daughter may get smaller and smaller each time. When a minimum stage is reached, nature resorts to special methods to restore size.

Sometimes at this stage, the protoplast sheds both halves of its shell and goes through a resting period, not dividing, just growing. When full size is reached, the organism forms a new shell.

Sometimes the protoplasts of two small diatoms escape from their shells, meet, and fuse. Then from the so-called auxospore a full-sized diatom develops. There are also other methods.

With two diatoms dividing into four, four into eight, eight into six-

teen, ad infinitum, there might soon be more diatoms than all the people that have been born on earth since time began. Those swift generations would soon clog the oceans if they were not gulped down as food and if their own food supply were not limited. The diatom itself gains food by photosynthesis, somewhat as do more familiar plants, and by absorption from the water.

What grass is to the land, the diatom is to the sea. Ocean life pyramids up from this flowerless midget plant. Copepods and other crustaceans that stain the ocean eat diatoms. Porpoises, shrimps, and fishes eat copepods. Seals, whales, dolphins eat shrimps. Thus the pyramid grows.

Diatoms provide a large percentage of the diet of oysters and the young of large fish. Sardines, menhaden, and parrot fish select diatoms as a main part of their food. Herring and mackerel swallow the tiny plants on long migrations—swallow them easily without slowing their migratory pace.

No diatoms live below about 600 feet—the limit of ocean vegetation. Beneath this, a deep blue endures, ever deeper in descent and flashing with stars—the torches and glowing "portholes" of fishes and other luminescent creatures.

Down through the depths falls an invisible hail. Down through the realm where first all red colors are quenched out, then the greens, and finally the blues. The diatom acts out its delicate role, dies; and the insides of its shell perish and disintegrate. The outside, closed up but empty, sinks to the ocean floor. Or it may dissolve on the way down and return as silica to the water.

This immeasurable descent in seas and other waters, this hailing down of microscopic shells, goes on unendingly, unseen. It is known that subsurface currents transport the nonliving diatom shells, perhaps over great distances. The diatom shell in its descent stays transparent, translucent, opalescent. Only when clean and dry, in air, or under reflected sunlight or under balanced light is it white.



▲ Most of the diatoms used commercially lived and died in the Miocene period, which lasted roughly from 12 million to 28 million years ago. The California coast for some distance north and south of the famous deposits at Lompoc were then under water as shown here.

So enduring is this fall of shells, sometimes in lesser, sometimes in greater amounts but without ceasing, that it has laid a thick carpet of encasements here and there on the ocean floor, down in a realm of utter blackness. Here lie the jeweled mementos of long ago. They have survived pressure of 7 tons per square inch, but that is because water is both inside and out. They are not uncrushable. Many have been broken during the millions of years that have elapsed since they fell. The little, intricately carved boxes which we think of as white accumulate at depths where the color white does not exist. Then some of the ocean bottom upheaves, or perhaps it is a laden lake that upheaves, and they are brought near or above the surface. They may lie hidden beneath later deposits until an abrasion in the earth's crust makes them visible. Men find them, quarry them, call the encasements *fossil flour* and their earth *diatomite*.

New Zealand, Japan, Russia, Germany, Canada, Spain, Portugal, and Italy have diatomite deposits. Large amounts are in Africa. A bed lies at the bottom of a lake on the island of Skye off the coast of Scotland. Diatomaceous ooze carpets a broad belt in the antarctic. Another belt crosses the North Pacific from Alaska to Japan.

At least 150 sizable deposits are known in the United States—in California, Oregon, Florida, Idaho, Nevada, New Mexico, New York, New Hampshire, Massachusetts. Diatoms in greater or lesser amounts occur in sediments of a great many lake beds, in swamps and marshes resulting from lakes, and in oceanic fringes. Deposits underlie parts of Richmond, Virginia, from a few feet to 30 feet thick.

The thickest deposits of diatomaceous origin in the United States are near the Santa Maria oil fields in California. Here the main deposit is 1400 feet deep. Does the nearness to oil fields seem strange? Diatoms store up food in the form of oil, oil more like dolphin oil than vegetable oil. They may be a source of petrol-

eum, but geologists do not rest the question there.

From two to eleven per cent of a living diatom may be oil. One authority estimates that in a diatomite deposit the size of the one at Lompoc, diatoms could have produced enough oil to fill a lake twelve miles square and fourteen feet deep. But that oil would long since have been dispersed.

Because of other substances in the ooze, diatomite may be cream, gray, tan, green, or almost black. Exceptional purity makes the Lompoc diatomite white.

When volcanoes were erupting along our present western coast, building the great cones of Shasta and Hood, diatoms were laying down their layers on the ocean floor. Parts of the floor heaved up, were eroded, then worn down. Rain seeped through the shell layers, washing, purifying, draining away other kinds of ooze. Epochs passed. Gradually further erosions revealed some of the white.

Early Discoveries

Meanwhile our coastline developed, and in the seventeenth century, explorers cruising in the vicinity of the Palos Verdes Hills may have exclaimed, "That looks like snow. Snow in all this heat!" The snow did not melt, did not even feel damp.

Even back in the sixth century, diatomite had its renown. Justinian the Great ordered diatomite bricks to repair the Cathedral of Santa Sophia in Constantinople.

In 1866, Alfred Nobel of the Nobel Prizes, trying to tame nitroglycerine for commercial use, added Germany's diatomite (called kieselguhr). The diatomaceous earth was the "carrier"; its porosity soaked up the nitroglycerine and made it less dangerous in handling. Result: the first dynamite.

In 1893, near Lompoc, the Balaams, father and sons, took out chunks of the white material and sold them in San Francisco for heat-insulating material. The porous white stuff retarded the exchange of temperatures. Furthermore, you

could try to burn it—throw it into the flames as Charlemagne is reported to have done with his asbestos tablecloth to clean it—and it would emerge not even scorched. But to the Balaams, diatomite was only a sideline. They farmed.

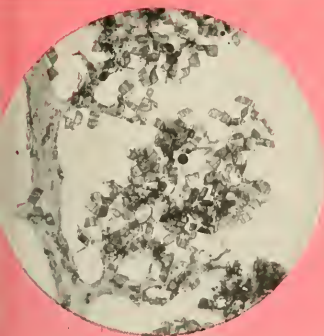
Ranchers became interested in the strange white chunks of stone and marveled that they floated in water.

"I put a piece into a gallon of water," one would say. "It soaked up every drop and still looked dry. Felt dry, too." Or, "My Janey gathered up a whole armload, like picking up a rag doll. As lightweight as that. Think of her lifting up that much."

Ranch business boomed. The Magne Silica Company formed. In 1912, Arthur Krieger of Milwaukee, having studied kieselguhr in Germany, formed the Kieselguhr Company of America. He knew Lompoc's deposits to be pure and began producing the filtering material that was later given the name Celite. When this company sold out to Johns-Manville, the name Celite remained.

A cross section of those extensive deposits at Lompoc reveals layers that prove periods of greater and lesser fall. There seems to have been a strangely steady rhythm, with the diatomite strata folded into arches and troughs. Over 300 species of diatoms are found there—tiny jeweled snus, ovals, footballs, triangles, many fragmentary, all exquisitely dotted and rayed, all of marine origin, dating mostly from the Upper Miocene period. The Miocene is considered the Golden Age of Diatoms.

The workable deposits at Lompoc, only a fraction of the total, cover about 4 square miles and are 700 feet deep. Power-driven shovels and other equipment dig the white chunks from the hills and load them into trucks. The trucks deposit them in "glory holes"—shafts sunk right into the solid diatomite. Railways move through two miles of tunnels to central storage bins, where pillars of diatomite support the underground roof. From the bins, the



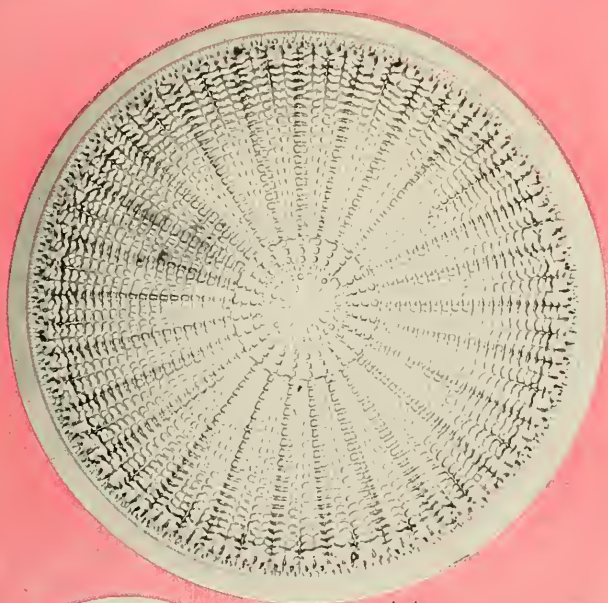
▲ SOME DIATOMS live singly; others cluster on larger algae or other supports, as shown in this photograph of *Isthmia*. The magnification is 13 diameters.



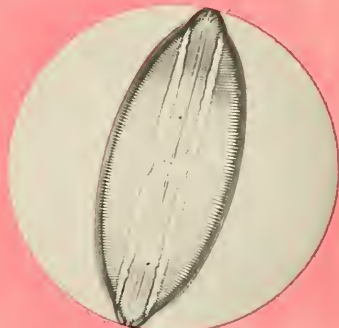
◀ A REMARKABLE PHOTOGRAPH showing how the edges of a diatom "shell" overlap. This specimen belongs to the genus *Navicula*. (Reproduced at magnification of 500.)



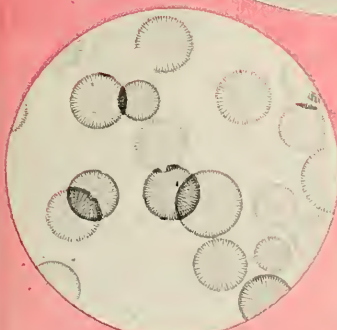
▲ THIS is how *Asterionella formosa* looks when magnified 230 times.



▲ *ARACHNOIDISCUS EHRENBERRGII*, about 400 times natural size.



▲ *NAVICULA LYRA*, reproduced at 500 diameters.



▲ EVEN at only 33 diameters, the exquisite designs of the diatoms can be beautifully photographed. (*Arachnoidiscus*.)



▲ *PLEUROSIGMA ANGULATUM*, magnified 125 times.

◀ *AULISCUS PRUINOSUS* at a magnification of 600 diameters.

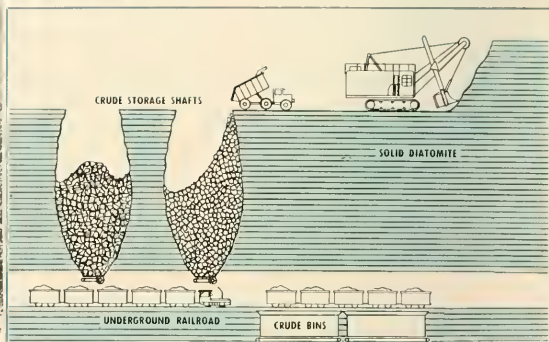
Roy M. Allen photos



Johns-Manville

◀ TRUCKS, like this one, dump the crude material into storage shafts that are cut in the deposit. The shafts are emptied from below.

▼ TRAINS OF CARS travel underground as shown here, to be loaded from the storage shafts.



chunks progress to mills, each mill adjacent to a hill.

Having lain underwater for eons, a Lompoc block contains about 40 per cent moisture. Men remove this by careful milling and drying. Diatomite can take in three times its weight in water. But fortunately it absorbs little moisture from the air.

Its huge absorbency is due to its inner spaces. A whole handful weighs almost nothing. A cubic foot of the best diatomaceous earth when powdered can weigh as little as ten pounds. Even a half pound or less can boast a surface area of about 45,000 square feet—the size of a football field!

Porous, lightweight, enduring, this stuff is also chemically inert. Only hydrofluoric acid and hot alkali solutions affect it in any way.

Hold some in your hand. It looks like dry white chalk. Press a little between thumb and forefinger. Do you feel the midget grit of separate shell cases?

In the 1890's, Captain William Borrows of San Francisco told how he mixed some white blocks with other ingredients to insulate steam-pipes. Owners of icehouses began talking about diatomite's ability to imprison the cold.

At first, men shied off from using it in excessively hot temperatures. "Risk it for extreme heat? I'd rather

▼ HERE one of the underground railways is emerging, loaded with crude diatomite that has been dropped to the cars from underground bins. The train will carry it to the primary crushers, after which it will be dried, milled, and purified by a series of classifiers and cyclone separators.



lose fuel." But gradually tests proved it safe for blast furnaces, boilers, and kilns, even at temperatures over 1000 degrees F. Johns-Manville processes diatomite with asbestos and other binders for boiler furnaces, hot blast stoves, petroleum cracking furnaces, producer gas mains, and many other types of industrial equipment.

In North Africa and in the South Pacific during World War II, diatomite filtered the drinking water for our troops, removed organisms that

cause dysentery. It also insulated submarine linings.

Chief uses today are as filter-aids and fillers. Diatomite is sometimes used in filtering public drinking water and swimming pools. It is a filter-aid for all kinds of sugar liquors and syrups. It makes for sparkling clarity, gives beer its sharp brilliance. It helps recover dry-cleaning fluids, clearing them for re-use. It helps process water for papermaking.

Diatomite is added to help liq-

uids flow through filters freely without clogging. It is graded, so that a special filter-aid can be used for each purpose to eliminate unwanted particles or to let desired particles pass through, as with orange juice, prune juice, and grape juice. The finest textures are used to clarify vinegar, milk sugar, gelatine, extracts, yeast food, glues, chemicals, metal compounds, and many pharmaceuticals. Middling-fine diatomite is used for dyes, lacquers, liquid soaps, crude and refinery oils, shellacs, glucose, antibiotics. Coarse diatomite filter-aids are used for adhesives, casein, cider, dextrose, cellulose esters, heavy oils, synthetic resins, textile sizings, tar, varnish, wax.

Diatomite is used in house paint, varnish, and lacquer. It absorbs oil lightly; its tiny protrusions of silica diffuse light gently, retard cracking and flaking of paint, and serve to

increase the visibility of night signs. Diatomite adds thickness to paper, helps it absorb ink, and is used as a filler in fertilizers.

The abrasive power of the scrubbing powder used in your kitchen sink may be due to the tiny fans, stars, and other shapes that diatoms wove for themselves eons ago. Those fine polishes for your car, for metals, glass, and airplane bodies hold diatomite—to clean brightly without scratching. The strength of plastics, the safety of safety matches, are due largely to diatoms.

Diatoms enter the whole complex world of catalysts. They help in the manufacture of sulphuric and phosphoric acids, linoleum, artificial leather, cosmetics, phonograph records, pavements, roads, wallboards, floors, and roofs.

About 150,000 tons of diatomite a year come from the Lompoc deposits. If 40 million diatoms make up a cubic inch of porous white, how many are in a ton? You'd almost need an electronic computer for the answer, the stuff is so lightweight.

Diatomite business in the United States totals about \$15 million a year. Some diatomite is made up of marine deposits, some of fresh water. All the most important economic workings to date are from diatoms of the Miocene period.

See It for Yourself

Dip up mud from a sizable pool and smear some under the microscope lens. Better to take your sample from sluggish water, preferably greenish or brownish and slightly oily. Scoop from the bottom of the pool and along the edges of ma-

roomed leaves. Avoid green scum; this is mostly spirogyra. Without lingering, place a drop onto the slide of a microscope with a 10-power eyepiece and an objective of, say, 43X. You may detect some green algae and a tiny creature or two of the animal kingdom, but you are looking for diatoms. They will vary in shape and markings. But if they look crystal-hard, have symmetrical and intricate designs, and move forward, stop, retreat, or move off in a slightly different direction, and if they do this repeatedly, they are probably diatoms. (Desmids also move, but slowly and in a straight path.) Draw a picture of the objects in their relative positions; notice a little later how the positions have changed. This will help you in spotting the diatoms that are capable of motion.

Watch the impressive dignity of these living organisms as they move almost beyond the field of vision, pause, and perhaps return in almost identical paths. Detect the dying, each perfect case with its multiple filigree holding an expiring bit of protoplasm. Look down on the remains of the already dead, the helpless jewel boxes, one side quietly closed over the other, with no movement whatever except to fall.

Where did diatoms come from, and how? Are they, in their prodigious numbers, to outlast man? Who can tell? We only know that they help us in a thousand ways. Through our varied industries they are of crucial importance to us from morning to night—these tiny ancient plants, which the man on the street may never have heard about, or ever seen.



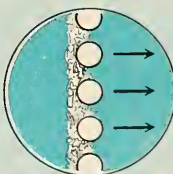
Johns-Manville

▲ A BLOCK OF CRUDE DIATOMITE is so light that it easily floats on water. The tiny air spaces that make it buoyant account for its unique value as an insulating material.

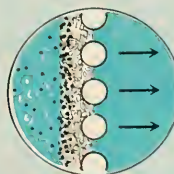
Filter action of diatomaceous earth.



If Celite filter powders are not used, fine solids form a seal over the filter surface and stop the flow of liquids.



The first step in the use of Celite is to build up a "pre-coat" of Celite filter aid on the filter medium.



During filtration, small amounts of Celite are added to keep forming a fresh filter surface.



▲ THE LITTLE CREATURE defied the photographer with rows of tiny teeth and mighty hisses. Its body was only about five inches long. Perhaps it was bluffing, but no chances were taken.

► ITS BROWNISH FUR was fine and soft, but it lacked the long guard hairs of the Virginia opossum. The animal moved with amazing speed and silence on its padded feet. Even when climbing, it made little noise.



POSSUM without PASSPORT

This miniature marsupial got past the immigration officials by hiding in a bunch of bananas, family and all

By JACK DERMID

Photographs by the author

SHIPMENTS of bananas arriving from the tropics do not always contain bananas alone. Strange creatures from foreign lands are frequently found hidden among them, as most dealers will testify. These curious stowaways include venomous-looking snakes, giant spiders, lizards, even iguanas and small mammals. One animal appears with such regularity that it has been nicknamed the "banana stowaway." This is the murine opossum (*Marmosa* sp.).

At first glance, this small opossum with short brownish fur and naked tail looks like a partly grown rat. In fact, the word "murine" comes from the Latin word for mouse and signifies mouselike or ratlike. But instead of protruding incisor teeth and blunt snout, the murine opossum has a long pointed muzzle and a mouthful of tiny teeth. Other opossum characteristics soon become apparent. The tail is a useful organ instead of merely something to drag behind. The ears are naked

and leathery, and the hind feet are equipped with an opposable thumb. As the rat characteristics fail to materialize, the little creature suddenly becomes cute, a miniature replica of our Virginia opossum except that it lacks long coarse guard hairs in its coat.

How *Marmosa* can hide away in a load of bananas and travel a thousand miles or more without being discovered or perishing is amazing. From grove to dealer, the bananas are subjected to much



▲ ITS TAIL WAS almost half again as long as its body. It hung like this with tail and hind feet but was not observed to hang by its tail alone, though probably capable of doing so. It moved about mostly at night.

▼ SOMETIMES THE ANIMAL would thrust its body slightly forward and box with its front paws. It did not need to have its feet on solid footing to gape and hiss.



handling. The bunches are cut from the trees, graded, weighed, dipped to kill insects, loaded and unloaded many times, hauled from place to place, and finally stored in ripening vaults until ready for the retail market. *Marmosa* has quite a varied journey.

The ocean voyage alone must be a rough ordeal for an animal accustomed to tropical climates. Carl G. Hartman in his book *Possoms* tells that the holds of banana boats are held at the favorable ripening temperature of 57 degrees F. Since ripening fruit consumes a great deal of oxygen, the air is continuously changed, and he suggests that *Marmosa* may move to the intakes and live there on insects carried in by the warm air.

Regardless of the difficulties of travel, a murine opossum arrived safe and sound not long ago at the Beasley Produce Company in Raleigh, N. C. The animal was not discovered until the bananas were being stripped from the stems. A worker cutting away a hand of bananas found a curious little nest about the size of a grapefruit, composed of dried leaves and shredded stems. The nest looked empty, but no chances were taken. The worker cautiously opened it with the blade of a knife, and the startling little creature reared up through the

leaves, hissing with all its might. Its open jaws revealed long rows of tiny teeth, and its big teardrop eyes glistened. The little monster was quickly captured in a large fruit jar and hustled away to the North Carolina State Museum, where it was identified as a murine opossum. There was room to spare in the jar, for the tiny animal's body was only about five inches long. Its tail made up the rest of its twelve-inch total length.

Lady opossum not alone

Then the great discovery was made. The little lady was not traveling alone. She had brought along a family of seven very immature youngsters. They were attached to her breasts and did not resemble their mother at all. They were little more than partly developed embryos, with oversized, grotseque heads and stumpy legs. Dark round spots under the naked skin revealed the future location of their eyes. It is characteristic of marsupials to bear premature young, but the murine opossum, unlike its Virginia cousin, does not have a brood pouch for holding its babies during the early days of development. They simply attach themselves to the breasts and dangle freely. In captivity, unfortunately, this particular brood gradu-

▼ NOTE HOW the murine opossum's opposable thumb on the 1 foot can grip a branch. Although bluffing here, the animal could use jaws effectively and on several occasions caught a large beetle mid-





▲ SEVERAL TYPICAL OPOSSUM FEATURES are revealed: long whiskers projecting in all directions, naked and leathery ears, and a crease down the front of the nose. Some murine opossums are said to have become good pets.

ally became detached and perished.

A look at the bill of lading revealed that our little immigrant had traveled quite a distance from her native home. Steaming banana groves in tropical Ecuador had been her point of origin. She had boarded the steamship *Helena* not far from the equator, passed through the Panama Canal, docked at Charleston, S. C., and then traveled some 250 miles by truck to Raleigh.

Besides the insects she may have captured at the air intakes during her journey, she feasted on bananas, for a number of partly eaten ones were found near her nest. In captivity, she continued to eat bananas regularly, but she

would also accept raw meat and other foods. Her favorite dish seemed to be insects, particularly large beetles, which she munched with relish, producing a sound like someone crunching on popcorn.

Madame Marmosa customarily slept by day and became active at night, moving about her cage with surprising speed and quietness. When hungry, she would pounce upon beetles as fast as they were tossed into her cage, sometimes catching them first with her front feet, at other times directly with her jaws. Should a beetle fly past, she would bite it out of the air.

Although this murine opossum lived over two months in captivity, she never became tame enough to

be handled freely. Whenever an attempt was made to pick her up, she would rear back on her hind legs, hissing and flashing her jaws open. Perhaps she was only bluffing, but it was an effective bluff that quickly discouraged would-be handlers. When pressed, she would flee; she was never observed to play "possum" or feign death. Such wildness is not always displayed by the murine opossum. Some of them have made interesting and friendly pets.

The murine opossum is truly an interesting animal personality. A number have turned up in this country as banana stowaways. The reader may someday hear of one arriving in his home town.



▲ Umutina men, dressed for the first dance in a cycle of eighteen rituals. They are holding flutes so sacred that they must be kept hidden except when in use. This ceremony was photographed by Harald Schultz for the first and last time. The tribe has already been exterminated by civilization.

here
come
the
Umutinas!

part II

Almost Murdered

An anthropologist tells how he was suddenly attacked while living alone among the Umutinas, deep in the Brazilian wilderness

By HARALD SCHULTZ

*Staff Anthropologist of the State Museum, São Paulo, Brazil
Photographs by the author, SPM.*

THREE months of hardship led up to this incident, hardship not only for me as a white man living among the Umutinas but for the Indians themselves. It was 1945, and an epidemic of whooping cough and dysentery was raging. Food had run short, and the land was

charred by the worst fires in many years.

When I first met the Umutinas, scarcely anything was known of their life. I had collected notes on some of their important rituals and had reached a point where it seemed possible to witness and record their

most sacred ceremonies, which had to do with honoring the spirits of the dead.

For the first three weeks of this difficult period, I was thankful to have a voluntary helper, a brave young Brazilian named Otto Ernesto Mohn. After that, I was alone,



▲ WITH THEIR ENTIRE BODIES painted black and with white pompons adorning their faces, the men danced hour after hour in this deeply religious ceremony having to do with life and death. The women remained in the houses throughout but answered the songs of the men.



▲ THESE STICK-BUNDLES are symbols or fetishes representing the wild pig. The dancers, who wear masks and other regalia so as to impersonate spirits, are given gifts of food prepared by the women. They give formal thanks.

► BEST INFORMED of the Umutina story-tellers and sister of the Indian who attacked the author: Matarepatá. She wears her hair short in the Umutina fashion for women. The rings in her ears are carved from palm nut and embellished with bright feathers. Her necklace is of seeds and monkey teeth.



and the nearest Indian post was 50 miles away.

All the lands up-river had been destroyed by fire. It had rushed through the forest on the river banks, burning bark, branches, and leaves. Lakes were so dry that almost no fish remained in them. There was no game in the jungle. The fire had burned a great part of the lands cultivated by the Indians, and the rest had been eaten by uncountable grasshoppers. Disease, death, and destruction stalked the land.

The Indians blamed it on the white man.

"*Uáse pikína!* The bad white men have put fire into nature," said old Jukuépa, trembling. "It has burnt our forest, our crops, even our houses." (During an absence of several days on a fishing trip, the people had lost their big houses by fire and were now forced to live in little huts.) Jukuépa raised his arms angrily and shook them: "Our children are ill. They will all die!"

The smoke made it difficult to breathe while lying in my hammock under a mosquito net, and our fight against the whooping cough was

not always victorious. All unvaccinated children died. The disease took the form of bronchial pneumonia among the adults and killed Jukuépa's mother-in-law, among others. Fortunately, the Umutinas still trusted me enough not to blame me for the deaths.

With the coming of the rains, orchids blossomed on the dry trees like pink drops of blood, and soon the whole forest turned green again. The corn grew, game came back, fish swam to the headwaters, and the disease started to decline. But of the 23 Umutinas I had originally known, only 15 now remained.

We were all exhausted by the fight, but I still wanted to witness the death cult rituals.

The Ceremonial Ground

One day, all the men disappeared. "Where are your husbands?" I asked the women.

"They are hunting in the forest," they tried to convince me. They did not want me to be here during these ceremonies.

Finally, Atukaré's wife laughed and said, "No, it's a lie. They are preparing the dancing square for the

Adoe rituals hidden in the forest."

We followed the foot tracks and found the men working hard, cutting trees and clearing the land.

"Look, everybody," I said. "I have a good surprise. I have saved a box full of brown loaf sugar to sweeten your beverages during the dances. It is yours if you will let me stay."

Old Jukuépa talked with the others. Presently he said: "It is agreed, but we shall have to build a house for you here close to our dancing square."

They started at once, and my straw hut was ready next day. This was about a mile from their village, and I often walked back through the jungle to have a meal with Kupo and his wife.

The first sign that Kupo was feeling aggrieved came when I was walking toward the hut one evening. He had always been friendly and had helped me much in understanding the Umutina rituals. But this time I overheard him talking excitedly with his elder sister.

"*Uáse pikína, uáse pikína!*" he was saying. "I hate all white men. They have killed everybody and they are



▲ THE AUTHOR photographed some of these ceremonies before he was attacked, but he returned to the tribe afterwards to photograph others. These rituals are dedicated to the souls of the ancestors, particularly those who had died during the year. Each dancer personifies one or more of his dead relatives, and the masks and dances keep changing.



▲ THE CHIEF adorns the dancers for the death cult ceremonies and has to provide the expensive red dye, nruucú. The dancers have to pay him the following year with part of the fish and game they secure.



▲ A DANCE dedicated to the spirit that gives good fishing, Jurima, who was once a powerful chief. The dancers hide their faces with their own hair. Old men without much of it wear special hair masks.



➤ A DANCER in the Bakuré with the woman who was the nearest relative to the deceased. The little child joins his mother, afraid of staying at home alone when there is so much noise and spooky activity.



▲ ONE OF the few nighttime dances. Each man holds a long stem of a palm leaf, split at the upper end so he can rattle it. The dancers sing in high-pitched voices, gossiping about everyone's life. Even the author came in for criticism because he was always bothering them with his cameras and seemed never to understand the real beauty of the enactment.

responsible for all our sadness."

I went up to him and said in a friendly way, "What is wrong, Kupo?"

He looked at me, and his face showed hatred. He then told me how, many years ago, his father and uncle had gone out fishing with the bow and arrow. While they were walking along the banks of the Paraguay River, some white men had come up the river carrying machinery for dredging gold. The white men had shot both his uncle and his father. Bullet holes in their bodies later proved this.

A few days after this conversation, things got worse. Kupo came into my hut and sat down without a word. He remained uncommunicative, and when a little later his wife came, I saw that they did not talk to each other. I decided that there must have been a family dispute, and I didn't want to become involved. But after a couple of days,

there was still no peace in Kupo's home.

Heavy rains came. The river was full and muddy, and we had no fish. The drowned forest allowed no hunting, and we had no meat for several days.

The Misunderstanding

The fourth day brought bright sunshine. Feeling hungry, I walked over to Kupo's house. Only his wife was there, with the two children.

"Where is your husband?" I asked.

"He is not here," she answered, turning her face to the ground. "He has gone — abandoned me. He said that I could stay in my relatives' house with my little daughter and that you should take his son with you to educate him among civilized people."

I now know that Kupo's wife was really joking, at least in part. But I made the mistake of siding against

Kupo in the presence of the children. "But where is my three-barreled gun?" I said.

"Kupo took it, and he will never come back," she answered.

The loss of my hunting gun was serious, and I started thinking about how I could live here alone, entirely dependent on the Indians for food. I grew angry:

"If Kupo, your husband, has abandoned you, he is a very bad man," I said, "a runaway and no friend of mine any more. He is a low thief for having taken my gun."

Both the children were listening. Atiaká now smiled and said: "It was only a joke. My husband is out hunting and will be back soon."

Then shots were heard, and some of the Indians in the village said: "Kupo must have killed game. There were three shots."

About midday, they told me that Kupo had killed two monkeys and a big deer. The monkeys were already boiling, I was told, in a clay pot at his sister's house.

"Go at once," said Kupo's younger sister, "Go, my brother killed a deer for you. Now you will have plenty of meat for many days."

I had now forgotten about the lie Kupo's wife had told. I never thought that the children might tell him the names I had called him.

I found Kupo beside the small kitchen hut near his house. It consisted only of four poles covered with a straw roof. He was kneeling, skinning an animal with my big jungle knife, and he paid no attention to me. I sat down on a tree trunk near the fire.

"What kind of an animal is that, Kupo?" I asked. "Is it a deer?"

He didn't answer. I repeated the question. Still no answer. Now I saw his face. He was angry. I hesitated, then shouted:

"Now, Kupo, what does all this mean? Take off that ugly, angry face. This is childish."

I knew almost at once I had made a mistake and had spoken too severely. Sickness had left me tired and weak from the work of many months. I had forgotten that the best way to gain the respect of In-

dians is to be calm under all circumstances. And Kupo's children had told him that I had called him a liar, a thief, and a deserter.

Kupo moved toward me like a wildcat. He lifted the big jungle knife over his head and brought it down in a heavy stroke over my left shoulder. The blade cut deeply through all the muscles, stopping only at the shoulder blade. Blood poured out over me at once, running down my naked body. I was wearing only shorts and sandals.

"Kupo!" I cried, "what are you doing? Stop this." I jumped from my seat, trying to escape his second attempt.

There was only one way open, and I started running backward out of the kitchen, followed by Kupo with the knife. I had no weapon. I had left my Mauser rifle on the wall of his house. Further, Kupo was strong and well trained. Behind his house was a new field, recently seeded with rice, and heavy tree trunks lay

around. I jumped over these but after a few jumps stumbled and fell to the ground on my back. Kupo arrived almost at the same instant and lifted his right hand high. He then swung the knife against my uncovered body.

I drew my legs back to protect my stomach and when he was close enough, pushed him with all my might. Later I found that he had cut me a little above the stomach, but at the moment I did not notice it.

Kupo's hands were slippery with blood and he lost the knife. It fell four or five feet from us, and we both tried to get it at once. I got it and rose to my feet, completely covered with blood.

Besides being too weak to use the knife effectively, I lacked the will to hurt Kupo, for he had always been my friend and he had two children who needed him.

He only jumped a little aside when he saw the knife and then began running to his house. He took

my Mauser Precision Rifle from the wall and aimed it at me.

"Kupo, stop, we are friends!" I called.

But he did not stop. I had only time to jump behind the trunk of a cut tree before Kupo aimed and pulled the trigger. The first bullet hit my left arm, which I could not hide. I felt the shock, and the bullet broke one of the bones. My left hand and part of the arm hung down without any movement.

Kupo was again loading. He was only about fifteen feet away when I heard the cartridge explode and felt the shock in my chest near the heart. There was only a drop of blood, but then my chest started to swell from the blood inside the channel made by the bullet.

There were five cartridges in the magazine of the rifle. Kupo lost the third shot, and while he was reloading, I ran toward a high cornfield. He could have killed me easily this time, but he missed.

▼ THESE FIGURES wearing enormous "masks" are accompanied by women, while the chief follows, singing and rattling. The two black-headed storks are believed to harbor the spirits of dead relatives. They take part in the ritual in their own way.





▲ A YOUNG Umutina girl, Hodoto, at left. At right: JOAQUIM, the son of the Indian who attacked the author.

I started walking inside the cornfield. It was high enough to hide me completely. I went about 200 yards. All this had been such a shock that I could scarcely believe it had happened.

Fifty Miles to Nearest Aid

It was midday and frightfully hot. I was very thirsty, and my left arm, hanging backwards, hampered me badly. I entered some thorny bushes, which gave no protection. The blood was still flowing from me, and I was now completely red. The wound on my shoulder was deeper than my open hand and twice as long. I sat down on a termite nest. The chest wound was beginning to be bad. Twice the blood came from my mouth, and then it stopped. Blood-thirsty ants climbed up my legs and started biting me with their pincers.

Suddenly the silence of the midday jungle was broken by the sound of crunching leaves and the chirping of birds. Someone was approaching. I could only think it was Kupo, returning to finish me off, but I was too tired to try to escape. I lay low. The footsteps stopped, and about 30 feet away I saw an Indian, his body painted completely red with urucú. It was not Kupo. It was Yarepá. He stared at me and gave a surprised, "Ough!" Then he went back into the forest.

I started to run again. I lost my jungle knife and hat but did not care. I did not know why Kupo had tried to kill me or whether all the Umutinas were against me.

In my present condition, it would take four or five days of steady walking to get to the Indian Service Post. I felt sure I would die before I could get there. I was still losing blood.

I lay down in a small square formed by four fallen trees, which seemed to provide a kind of fortress. But actually there was no protection.

A little later I again heard birds chirping and footsteps approaching. It was Yarepá's brother-in-law, who was also brother-in-law to my new enemy Kupo. He was carrying a big knife.

"Are you also angry with me, Mitoponcpa? (*Amé amokukwá iní?*)" I asked him. He said nothing but stepped nearer. When he saw me, he started weeping, tears falling to the ground. He tried to lift me to my feet, raising me as carefully as any nurse could have done. He got my right arm around his neck and urged me to walk. I took about two steps and then did not see or feel anything more. The world had disappeared.

I next felt light burning my eyes and I was hearing something. The thought actually crossed my mind that I was now dead. Then reality

came back to me like an explosion — all the sadness of my situation and a feeling of complete loneliness.

Two women were coming through the jungle; now they were cutting some wood. Yarepá and his brother-in-law were carrying a straw mat and a long pole. They opened the mat and laid me on it. I remember noticing that it was a very old and dirty mat. But they tied me securely inside it with a vine and lifted me on the pole. Their steps were unsteady, but they walked carefully, and when they laid me down and opened the mat, I found myself in their house.

I was given some watermelon, which helped to quench my terrible thirst. And then I asked Yarepá's brother-in-law to please get my medicine trunk. It was heavy, and half an hour passed before he brought it in. The Indians had to help me open the trunk. When I tried to sterilize the glass syringe for an anti-tetanus injection, I broke the glass where the needle is fastened.

Kupo's wife came in. She had seen her husband's attempt to kill me, but she was carrying a vessel of warm water and salt, and she began to wash my wounds.

"Kupo has asked me to tell you that he will soon come to finish his job," she said.

"Why did your husband do all this to me?" I asked. "Have I not always been nice to all of you? Have I not helped you during the sickness and saved two of your children?"

"Yes, Senhor Haroldo, you were good to us. But you spoke badly about Kupo when I joked that he had abandoned me, and my children told him."

Self-Preservation

I searched in my trunk for a valuable present, and said: "Please take this gift to your husband and tell him to leave me alone. I have never done anything bad to him. Tell him I have a child even as you have, who needs its father." She left me with this message, and my fear of death returned. But anger now took the place of my first feeling not to hurt my attacker, and I was now ready to defend my life.


continued on page 106



▲ THE TWO WOMEN who fed Dr. Schultz when he was knifed and shot: Hwarepatá and Matrepatá, with little Joaquim. He, too, wears the feather earrings characteristic of the tribe.

▼ INDOORS is almost outdoors in the land of the Umutinas. There are no partitions in the house. Each family occupies the space represented by the fire, work space, and matting on which they sleep.





◀ THE ROUGH STONE generally gives little hint of the beauty it will have when polished.

By

LEE BOLTIN

Photographs by the author

Ceylon- Isle of GEMS

▼ MOONSTONE BROOCH in gold setting.



From the mining of the gems in river beds and open mines to the bartering that takes place under a handkerchief, Ceylon's gem industry partakes of the lore and legend of the fabulous East

IN his chronicle *The Arabian Nights*, Sinbad, writing to his master Haroun al-Rashid, tells glowingly of the rubies and sapphires of Ceylon. And those venerable traders the Chinese long knew the island as Pa-Ou-Tchow, the "Isle of Gems." But even centuries before these visits, legend tells of Taprobane (Land of Copper-color) as the source of magnificent gems.

Under the rule of the medieval kings, the mining of gems was a royal monopoly. In recent times, however, the industry has been taken over by the Sinhalese and the Moors, more or less evenly

divided. The Sinhalese carry on the work of mining, both in pits and in the rivers; and the Moors take care of the cutting and selling.

Unlike many countries, the government of Ceylon owns all minerals found beneath the surface of the earth. It also superintends the actual digging process and collects a portion of the find. Here the universal conflict over taxation ensues, with a lively pursuit on one hand and clever evasion on the other.

There are two principal methods for extracting the treasure, both stemming from ancient times and both still very primitive. Pit mines, of which there are several hundred,

are simple vertical shafts that go down to an average of 30 feet. Small teams of Sinhalese work at the foot of these pits, scraping away at the mineral-bearing stratum. The material is loaded into circular woven baskets and carried to the surface. This stratum occurs usually in the bed of some primeval river, and the gems are trapped in small clumps of pebbles or of gneiss. It is these accumulations that are sought after.

River mining is accomplished by blocking off some of the swift water in a stream whose source is high in the mountains at the core of the island. A barricade of bam-

boo poles is thrown across the stream to lessen the current in the area that is being worked. A large hole is then dug in the river bed to the depth of about ten yards, and the gem-bearing soil is dragged to the surface with long claw-ended poles.

In both cases the material is examined while being swirled in flat, circular baskets with a steady rotary motion. The rough stones are extracted and put aside for further assessment. The whole process is a slow, laborious task, often with disappointment as the only reward.

The more desirable stones, sapphires and rubies, are not too frequently come upon. The more common moonstones and garnets occur quite often. A beautiful green-yellow chrysoberyl, the aptly named cat's-eye, finds its source here. Sapphires of superb quality, varying in color from blue, azure,

and indigo to gray and green, bring prices ranging up to \$10,000 and higher.

An extremely rare find, made a few years ago, was a twelve-rayed star ruby. This uniquely spectacular gem was brought to the American Museum of Natural History by one of Ceylon's leading exporters. So singular were its qualities that it was publicly displayed in the Museum and received a great deal of attention all over the nation.

In addition to the foregoing gems, amethysts, tourmalines, white topazes, and aquamarines are frequently found, as well as zircons.

Undiscovered Riches?

The original source of all these treasures is in the mountains. The endless rains of the southwest monsoon, feeding the many down-racing streams since time immemorial, have carried the mineral wealth to

the alluvial plain, and over the centuries the deposition has been enormous. Some geological opinion holds that a fabulous supply of gems still awaits discovery in the mountain fastness. Perhaps an attempt will someday be made to breach this Eldorado. Because of the difficult terrain, considerable investment in time and material would be necessary, even with modern machinery, but discoveries might be made that would make the world the richer.

In the shadow of Adam's Peak, legendary site of a visitation of Buddha and focus of uncountable pilgrimages, stands the city of Ratnapura. This is Ceylon's "City of Gems," the center of the island's gemming activity. Here the stones from the surrounding mines are brought to be classified, appraised, and put into the hands of lapidaries in preparation for final marketing. Usually the rough cutting of the

▼ **THE STRANGE HANDKERCHIEF GAME**, by which Ceylon's gem dealers and exporters determine a mutually satisfactory price through a broker. This practice has been followed for five or six centuries.

➤ **THE RIVER MINERS** scrape up the gravel from the bottom with poles equipped with claws. The usual bamboo barricade for slowing the water is just out of view here.





▲ THE MATERIAL is collected in baskets and inspected for valuable stones. Sometimes the men grapple to 30 feet.

gems is done by younger men as part of their lengthy apprenticeship. In the early stages of grinding, one person turns the wheel and also does the grinding. When a final decision has been reached determining the ultimate shape of the stone, it is turned over to the seasoned men for final faceting and polishing. The machines used are the simple wheel, sprinkled with abrasive and driven by the ceaseless cranking of an assistant. For some obscure reason, electric power, though available, is scorned by these master craftsmen.

Secret Signals

The most singular aspect of the whole process comes after the mine operator has sold his gems to one of Ratnapura's gem dealers. These dealers act as a kind of collecting point for gems. To their shops come the exporters, whose headquarters are in Colombo, the capital of the island and its principal port. At this juncture a third man is called in to

function as a broker. These brokers do not deal directly in gems but act only as judges to the transactions between the dealer and the exporter. The entire matter of bid and ask is carried out under cover of a handkerchief or similar small piece of material, with all the communications carried on through contact of the fingers alone. The hand-under-the-handkerchief technique started about 500 or 600 years ago. It has been accepted as standard operating practice ever since. The buyer and seller do not consult directly, and the decision of the broker is accepted as final.

This unique method is both picturesque and extremely practical. On one hand an arbiter, expert and honorable, gives witness and validity to each transaction. On the other, prices, always sensitive, are kept confined to the individuals concerned. In a field as competitive as gem trading, this is critical. Should any information concerning a particular bid become common knowl-

edge, the value of the gem could be seriously impaired.

In practice, the broker takes the asking price from the seller, always under the handkerchief, and gives it to the buyer. They then discuss a minimum figure and a figure for a first offer. This usually leads to much seasawing until a price mutually satisfactory is reached. Often, at the outset of the negotiations, the bid and asked price are so close that the broker will get the principals to put their hands together, one over the other, and will place the stone in question in the upper hand and state what he feels is a fair price. The transaction is then settled, and no more discussion can be entertained. For his efforts, the broker receives a fee of 3% from the seller.

From this point on, the purchaser will either take the newly acquired gems to his own shop to be mounted in settings or will export them. The beauty of these treasures ultimately brings pleasure to owners in countries all over the world.

▲ AS IT IS CUT, so it shines:
reflections from the facets of a sapphire.

▼ THE ROUGH POLISHING may be done by
an apprentice, operating his own wheel.



▲ FOR THE FINER POLISHING, the gem is set in a holder . . .

▼ . . . and carefully polished by an experienced man,
while an assistant tirelessly keeps the wheel turning.



Tree Ferns

If your vacation trip takes you to one of the places where whole forests of these giants can be seen, you will sense what the world looked like when coal was being formed

By HENRICKS HODGE*

All photographs by the author



BEAUTIFUL though they are, the lowly ferns that decorate our temperate woodlands give little idea of the size that some of their giant cousins attain. The tree ferns of the tropics stand head and shoulders above all other members of the great fern group. Some of them raise their slender trunks to a height of 60 feet—about the equivalent of a 6-story building.

The 300 or more species of living tree ferns inhabit the cooler temperature situations of the tropics and subtropics. They thrive especially well on lush, rain-swept mountain slopes where the torrid climate is tempered by elevation. There they may form small forests, particularly on abandoned agricultural land.

Tree ferns may be found growing as high as timber line, which in the tropics may lie above 10,000 feet. Seemingly the rainier the climate, the better these giant ferns like it. They are at their best in that montane belt where the cumulus clouds, sailing in from the surrounding lands, impinge upon the mountains, saturating them with mist or rain and forming what have been

◀ TREE FERNS and tumbling mountain torrents go together, for the giants of ferndom thrive best where tropical mountain slopes are bathed in mist and rain.



▲ A BEAUTIFUL ROSETTE of huge compound leaves, typical of all tree ferns.

fittingly called the “weeping woods.” It makes little difference whether the habitat be in Hawaii or the West Indies, in the Andes or the distant Himalayas, for the conditions are essentially the same the tropical world around. In these areas, the traveler will see tree ferns in all their grandeur, silhouetted as often as not in the fog, their delicate crowns conspicuous among the surrounding mass of vegetation.

Some tree ferns have wandered out of the confines of the tropics into the temperate zone. In the mild oceanic climate of New Zealand, for instance, they grow even

in sight of glacier ice. From that temperate land has come *Cyathea medullaris*, a tree fern that can stand even a few degrees of frost. This enables it to be grown in certain favored sections of the United States, such as California and Florida. On our Pacific Coast it can be seen in San Francisco’s Golden Gate Park, where the Pacific fogs, as they roll in, apparently give these alien ferns a welcome taste of their native atmosphere.

Resemble Smaller Cousins

Tree ferns resemble their more familiar lowly cousins of our wood-

lands except for their over-size dimensions and certain technical differences known only to fern specialists. The stems of most ferns are short underground structures called rhizomes, usually lying in a horizontal plane. However, the stems or rhizomes of tree ferns grow stiffly erect to form a tough, fibrous trunk.

Tree fern trunks are not to be compared to tree trunks. They lack the solid woody cylinder and growth layer (cambium) typical of the trunks of most trees. The tree fern trunk is incapable of growth in girth and grows slowly only in length from a single terminal bud. The giant leaves or fronds are at first tightly coiled in the bud in the form of elegantly designed “fiddle-heads” or croziers, as the reader may have observed among our common woodland ferns. The “fid-

*The author first admired tree ferns while hunting plants as a professional botanist in the American tropics. He now can admire them daily in the conservatory of famed Longwood Gardens, at Kennett Square, Pennsylvania, where he heads the new Department of Education. Massa-

chusetts-born and educated (Ph.D. in Biology, Harvard), Dr. Hodge has served as college professor, plant explorer in many tropical lands, and as principal botanist with the United States Department of Agriculture’s famed Plant Introduction unit.—Ed.



◀ **TREE FERNS** in a mountain glade in the West Indies. Fine stands of them can be seen near tourist routes in Puerto Rico and other parts of the Caribbean.

▼ **TREE FERNS**, like the modest ferns of our forest floor, have "fiddleheads," so called because they resemble the head of a violin. They are the tightly-rolled leaf buds. In this case, they are protected with spines and heavily clothed with scaly hairs.



dleheads" uncoil progressively, producing new whorls of leaves, and with each successive season, the gigantic green crown of the tree fern rises higher and higher.

Curiously, multitudes of tiny, aerial roots often grow down over parts of the trunk, covering it with an interlacing network. This serves as a wonderful footing for the growth of tropical air plants. As a result, tree fern trunks often look like green ferneries, cloaked as they are with mosses, tiny ferns, and similar plants.

In their arborescent form, at least, our existing tree ferns are perhaps our closest approach to those distant ancestors which, in the age of coal, first gave the earth a green cloak of forests. Most of the arborescent fernlike plants of those ancient times were the so-called "seed-ferns" (Pteridospermae). Where coal was being formed, these were more abundant than the tree ferns. Some of these

fern allies of long ago reached a height of 100 feet. There were, at the same time, true ferns of arborescent habit in those days, though none of them can be included in any modern family.

Kinds and Uses

The family that includes most of the living tree ferns is the Cyatheaceae. Another family, the Dicksoniaceae, includes most of the near-temperate species, all of the southern hemisphere ones of Australasian origin, and also the genus *Cibotium*, which includes two Mexican species. These latter are commonly grown in the United States as display plants for hotels and the like. They have pale green, much divided leaves, which are several feet long. They are sold before the tree ferns have begun to assume tree form.

Orchid fanciers in the tropics have long recognized the value of tree fern trunks and often cut them

to length and hang them up as supports on which to grow their exotic specimens. Fern trunks are termite resistant and make practically indestructible posts. Many a simple tropical dwelling stands on them. Long ago, the fierce Carib Indians of the Lesser Antilles found another use. They noted that dried tree fern trunks made fine tinder and used it as their standard material for carrying fire from place to place. Dried fern trunk will burn for hours, very conveniently without smoke or visible flame. The Caribs called it *watu hakuiyá*, meaning "voracious fire."

But of all the uses of the giant ferns, the one that seems most fitting is their utilization as ornamentals in horticulture. No botanical garden would consider its conservatory complete without at least one arborescent fern. Many a home owner in the tropics and subtropics feels the same way about these lovely plants. Certainly few species



▲ THIS ELABORATE GREEN TRACERY in but one part of a single leaf of a tree fern.

◀ TREE FERN LEAVES make some of the finest sky-patterns of the plant world.

▼ PHANTOMS of the "weeping-woods": tree ferns growing at 10,000 feet in the cloud-bathed atmosphere of the Andes at timber line.

can offer anything comparable to the lacey tracery of their magnificent leaves.

Next time you see one of these splendid plants, imagine a whole forest of them, on one of those breathtaking mountain slopes in the tropics, amid swirling mists and tumbling torrents. If you visit such a region on your next vacation trip—perhaps the Luquillo Mountains of Puerto Rico, Jamaica's Blue Mountain Peak, or the knife-edged ridges of Hawaii—you will be able to conjure up a good impression of what a good pteridophyte forest would have looked like eons ago, when the coal beds were being laid down for races yet unborn to burn in their hearths in climates too cold for tree ferns.





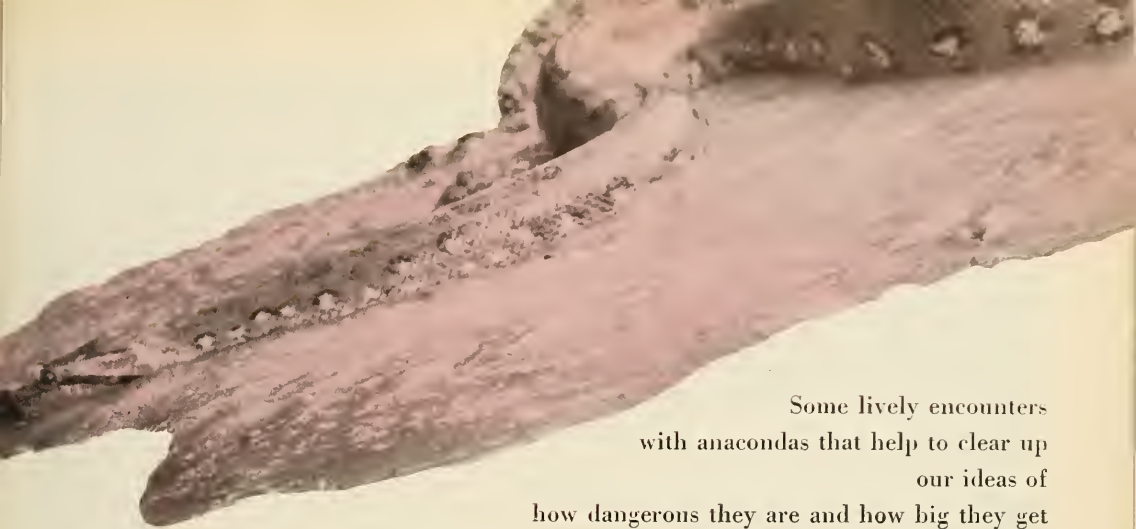
◀ THE AUTHOR with three baby crocodiles.



▲ THE SMALLER CANOE that the snake hunters used in exploring numerous narrow winding streams and little lakes and swamps.

▼ THE SNAKE-HUNTING EXPEDITION making its camp on the shore of the Putumayo River. The little creature in the foreground at right is the expedition's mascot, a young howling monkey.





Some lively encounters
with anacondas that help to clear up
our ideas of
how dangerous they are and how big they get

Giant Snake Hunt

By ROLF BLOMBERG

I HAD been told that the commander of a certain Ecuadorian military post on the Putumayo River owned an anaconda skin measuring more than 10 meters—about 33 feet. So I looked him up.

"That's correct," he said. "Actually 12 meters."

"But do you have it here?" I asked.

On many trips to the Amazon, I had been trying to find a record specimen. One is commonly told that there are anacondas measuring 30, 40, even 60 feet. A postcard turned out by a photographer in Manáos and sold all over Brazil shows one that is stated to have a length of 40 meters (over 131 feet) and a weight of 20 tons! What the photograph shows could be any anaconda between 4 and 8 meters, maybe more, but its length is impossible to determine since there is nothing in the picture with which to compare it. This postcard has

naturally helped the wild stories about giant snakes. But experience had taught me that those who claim to own a record-size skin generally can't produce the evidence. Usually they tell you that the skin has been given away or that it has rotted or been gnawed up by rats. I was therefore greatly surprised when the commander answered: "Sure, I have it here." He ordered a soldier to bring it.

Here was something of a sensation! A new record, I thought. Theodore Roosevelt had offered \$5000 for a skin or skeleton only 30 feet long.

The soldier brought the skin, and we unrolled it on the floor. It measured exactly 6 meters—only half the length the commander had claimed.

"That's a bit disappointing," I said. "Only 6 meters!"

"It's hard to believe," answered the commander, laughing. "I

thought it was 12, and it *looks* like 12, doesn't it?"

This inclination of people to exaggerate when it comes to snakes seems similar to the amateur fisherman's ability to add inches or feet to the fish that got away. I think it must be wishful thinking. But it is a more serious matter when the authors of books that are otherwise reliable talk frivolously about the possibilities of anacondas as much as 50 and 60 feet long. Such stories cannot possibly be taken seriously.

One reason there are exaggerated ideas about the size of snakes is that it is no trick at all to stretch a skin as much as 20 per cent. In this manner, an unscrupulous person is able to manufacture a much larger snake than ever existed. In fact, it is difficult to skin a snake without stretching the hide appreciably.

We also hear gross exaggerations about how dangerous the anaconda



▲ IN SHALLOW WATER, there is some chance of capturing a large anaconda, but in deeper water, the snake moves with such incredible speed that the attempt is almost hopeless.

is. Despite intensive research, I have only been able to find two definite cases of anacondas causing the death of human beings.

One man was killed on the Napo River in Ecuador, when he went for a swim and was entwined by one of these snakes. He struggled in vain to get away but was drawn under water and carried off. He was later found farther downstream, dead and bearing distinct marks of the ghost-squeeze. Evidently the reptile had been unable to devour so large a victim.

The other incident occurred at the mouth of the Yasuni River, a tributary of the Napo. Some children were bathing, and a boy of 13 suddenly disappeared. His friends were sure he had drowned. After a moment, they saw bubbles rising from a spot near the shore, and one of the boys dived down to search. He came up pale with fright. He had felt around for his friend in the water and had touched something he was sure was an enormous snake

—an anaconda! He had often been told that a gigantic anaconda haunted the river hereabouts. It was even said to have swallowed two persons. No doubt the same fate had now taken his friend. The dead boy's father was determined to take vengeance on the murderer and after a day and night of unwearied search, he discovered the reptile. It was lying with half its body on the shore, the other half in the water. It had vomited up the devoured boy. With five shots of his Winchester, the boy's father killed the snake. It was an enormous anaconda.

Filming on the Amazon

When I was at home in Sweden in 1952, I was offered a job as the leader of a motion picture expedition to the Amazon. The aim was to make a documentary film of an exploratory trip to this immense jungle country. Natives and animals were to be the main actors, and the climax of the film was to be the cap-

ture of a giant snake. I knew that there were plenty of anacondas in the region around the Putumayo and Caquetá Rivers in southeastern Colombia, so we set off for that locality. We had to make two expeditions, however, before we got our pictures, because during the first trip the rains caught us before we had finished our work. Neither were we very successful in finding a giant snake. The only anaconda we caught on the first trip measured 4½ meters (about 14½ feet), and we had certainly thought of a snake actor of more imposing dimensions. The capture of this reptile was nevertheless rather dramatic.

We were on our way down the Cagnán River, a tributary of the Caquetá, when we discovered this snake stretched out on the trunk of a tree sloping out over the river. It had been raining continuously for the last few days, but now the sun had peeped out a while, and the big snake had evidently crept up on the trunk to warm itself. She looked

much larger than she was, perhaps because she was very thick.

How could we catch her alive? It didn't look easy. If she threw herself into the river, we wouldn't have the slightest chance to get hold of her. To catch an anaconda in the water, especially in deep water, is almost impossible, because in that element the snake is incredibly quick. That is why we always try to find them when they have left the water to bask in the sun or to digest their food. We had brought a couple of nets, and if we could get one under the tree trunk, the snake would land in it instead of in the water.

With greatest care, we maneuvered our canoe closer. The snake didn't react. An anaconda hasn't got many enemies—at least, not an anaconda of this size. Crocodiles are the only ones, I suppose, so she probably didn't think we were anything to be afraid of. And that was her mistake.

We placed our canoe diagonally under the trunk but farther out, tying the prow to a branch so that

the current wouldn't carry us away. While Muñoz (the taxidermist) and Torgny (the film director) watched the anaconda with their guns in readiness, Jorge (a Colombian hunter) and I slid into the river and made our way to the shore, swimming and wading. We pulled the net along, succeeding with considerable difficulty in laying it out between the shore and the canoe right under the snake. But now the hardest part of the job came: to snare the creature.

Getting the Rope Around it

Slowly we approached the anaconda, each with a lasso. Still no reaction, only the tongue working and the hard, ice-cold eyes warily watching us. With great care, we laid a loose snare clear around the snake's body and the tree trunk. I was holding a lasso ready to pull as hard as I could, while Jorge, with a sheath knife between his teeth, waded out to try to lay another snare around the snake.

With twigs and leaves in the way, he couldn't get at it. He started cut-

ting leaves away, and the snake raised her head. Jorge stood motionless. The suspense was almost unendurable; seconds seemed as long as minutes. The anaconda let her head drop again. Then Jorge flung the line and got it around the snake and the trunk. He made a slip knot and threw the end of the line to Torgny in the canoe.

Now the very worst part came: to get a snare around the snake's head. Jorge tossed the line but missed. Now the anaconda started to move, sliding slowly forward with her head raised.

We couldn't wait any more!

"Pull as hard as you can!" screamed Jorge. We tightened the snares, pulling on them so hard that they cut into the flesh of our hands. The anaconda possessed an incredible strength. For all my hanging on to the lasso, with all my weight, she rid herself of the snare. I threw myself at her tail and pulled as hard as I could, but I could only hold it for a moment.

It looked as if we were going to lose our anaconda. She was fighting hard to make her escape. She would strain her body, then let it slacken, and in this way she pulled out of the snare inch by inch. With open, hissing mouth, she swung from side to side, lunging at Jorge but fortunately not reaching him.

We were all excited, Torgny most. He kept yelling: "Put the snare around the neck!"

That wasn't so easy! The snake was striking furiously in all directions and would not allow anyone to get near.

But Jorge was ready for action again. He went straight up to the anaconda and flung the lasso once more. This time he was successful. The loop went around the neck. He



◀ FOUR OF THE ELEVEN ANACONDAS that the men of the Colombian Military Base at Puerto Leguizamo found in a single tangle. The largest one was over 19½ feet long.



▲ AT LAST, THE BIG ONE WAS OURS . . .

pulled hard, throwing himself backward. At the same moment, however, the anaconda slid out of the other snare—the one around her body tying her to the trunk. She dropped into the water. The net wasn't where it should be! The current had carried it away.

Jorge wouldn't let go. I went to his rescue and helped pull at the lasso. Working together, we were able to drag our frantically wrestling prey toward the shore. The anaconda was lashing the water violently. Torgny and Muñoz also jumped into the water and hurried to our rescue. With united effort, we dragged the snake up onto the shore. Here the anaconda made a ball of herself, probably because

the snare around her neck made her want to protect her head. We brought the net, spread it on the shore, and pulled it over the snake, making a package of our anaconda. With a knife, we freed her from the snare, and she then began to thrust furiously in all directions, trying to get out of her confinement. But she could not break the strong, elastic net. We were all dirty, wet, and tired.

Warm bath for Señorita Ana

This was our first anaconda, and we named her Señorita Ana. She traveled with us all the way to Sweden. By the time we arrived at my home near Stockholm, she wasn't in too good condition. When

I opened the case, she was stiff and cold and didn't show any sign of life. I touched her, pinched her. No reaction. Dead? Oh, no. She was only "deep-frozen" after the flight from New York to Stockholm. We had been at 9000 to 13,000 feet, and Señorita Ana had had no heat in the luggage room. A warm bath, however, had a wonderful effect on her. Suddenly there was action in her long body. With a hiss, she opened her big mouth and struck swift as lightning against the broom with which I was handling her.

On the following days, the air was warm, and she took her sun bath on the lawn outside the house among tulips and other spring flowers. Then she traveled to the Goth-

enburg Aquarium, where a nice warm terrarium was waiting for her. Five months she remained on a food strike, but then she decided to eat and gobbled up guinea pigs and rats with good appetite.

A strange destiny indeed for an anaconda from the South American jungles.

Better Luck

Our second expedition was more successful, and we caught four anacondas. We took three of them back to Sweden. I will tell you about the biggest one.

An anaconda, as a rule, has a fixed hunting ground. So we gathered all the information we could about big anacondas that had been seen. Our best chance seemed to be on the upper Caucaiyá River, which rises in a swampy region north of the Putumayo. Some Witoto Indians, living near the mouth of the

river, had given us good hints and mentioned some small lakes and ponds where they recently had seen very large *güños*, as they called them. The Witotos considered us completely crazy, however, to want to catch these monsters; they kept earefully away from the places where they might encounter one.

Just before we started, something happened that seemed to point toward a good result. Some hunters from the adjacent Colombian military base of Puerto Leguizamo had had a strange adventure near the mouth of the Caucaiyá River. On the bank, they had discovered *eleven* anacondas in a single tangle. They shot four of them; the rest escaped into the river. The largest specimen was more than 6 meters long (about 19½ feet). Our guide was Obdulio Villamizár, "the best hunter and fisherman on the Putumayo," a tough fellow who knew the jungles

and swamps like his own trousers' pocket. In a 12-meter canoe with an outboard motor, we traveled far up the Caucaiyá, and in a smaller canoe belonging to Villamizár, we explored numerous *quebradas* — narrow, winding streams barricaded by brush heaps and fallen trees — and little lakes and swamps. We also made long and exhausting wanderings through the moist jungles, perpetually on the lookout for a giant snake.

We caught many kinds of reptiles, both poisonous and nonpoisonous, but there were no signs of anacondas. Yet we were determined not to give up the search, even if we had to spend a month or two longer in this unhealthy jungle, where two of us had already contracted malaria. The rainy season was drawing near, and once it came, our chances would be small.

We intensified our search, working from sunrise to dusk. At last, in a small tributary of the Caucaiyá, our efforts were rewarded. A fine big anaconda had been careless enough to crawl up on the shore.

There were five of us on the job, and we offered something of a blitzkrieg. We dived down on the anaconda with forks and lassos and a grim determination not to let her escape. The struggle was wild. We battled and pulled and tumbled down in the mud. The anaconda hissed and struck at us and made unceasing efforts to squeeze us. We yelled and perspired. Meantime, Kurt kept hopping about with his moving picture camera, trying to record the actions of the snake from all angles. Sometimes he was almost in its jaws. Olle Bohlin, our sound engineer, was kept busy with his tape recorder, but Torgny, the film director, didn't bother about any directing at this point. The snake attended to that.

Finally, the show was over. The anaconda was ours, safely in a big case that we had brought along for the purpose. All of us were utterly exhausted, but we had captured a snake that was 7 meters long (almost 23 feet) and nearly as thick as a telephone pole.

▼ ... and had to be content to travel to Sweden in a big packing case.





The Glacial

Proof of the Ice Age now stares us in the

IN the light of modern knowledge, we find little difficulty in visualizing the continental ice sheets of massive proportions that spread over northern Europe and North America during the past million years. We can understand how these great masses of slowly moving ice could pluck rocks and huge boulders from hills and peaks and move them hundreds of miles to the middle of a prairie or some other distant place. But the name "drift" was given to these boulders

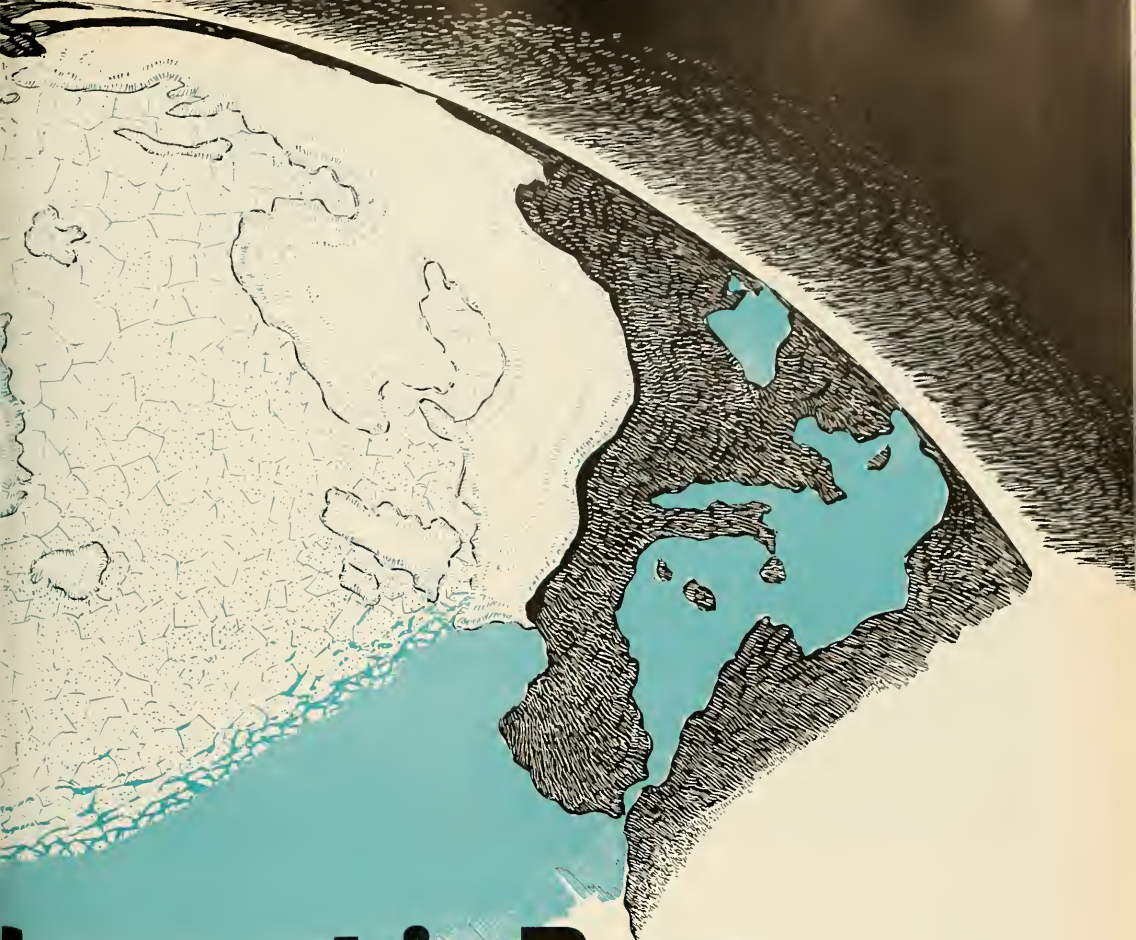
and assorted deposits of clay, sand, gravel, and cobbles because they were once thought to have been dropped from drifting icebergs. They are still called "glacial drift."

Glaciers were not always so easily understood. Nearly all geological concepts were born of modest beginnings, and the labor pains of the glacial concept were worse than most.

Tempers flared, jealousy reared its ugly head, and friendships were dissolved when scientists began ar-

guing about the origin of this mysterious "glacial drift." When some dared to suggest that glaciers far larger than any remaining on earth might have existed, they were ridiculed, and their observations, however brilliant, were disregarded. These ideas had to be born and reborn with varying interpretations before the scientific world accepted the Ice Age as a fact of geological history.

Curiosity about the debris left by moving ice sheets began in



Concept is Born

many wild guesses frayed scientific nerves before the truth came out

BY RICHARD J. HARTESVELDT*

northern Europe, much of which is covered with this glacial drift. Nearly all observers agreed that some large-scale means of transportation had been involved, but many wrong answers were suggested before the right one was hit upon. Biblical interpretations were favored, and there was a widespread

theory that an immense deluge of water had swept over the face of the earth, moving stones from one location to another and rounding them by rubbing them against one another.

Emanuel Swedenborg, in 1719, was one of the first to theorize along this line.

In 1740, Danial Tilias, an American, thought that a flood had been responsible, but he could not account for its origin. He made one excellent observation. He pointed out that granite erratics—rocks that had been carried away from their original location—were found at various distances from the parent mountain and that the greater the distance, the more rounded were the corners and edges.

When Benjamin DeWitt, also an American, noticed in 1793 that a

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Postpile. He holds an M.S. in conservation and an M.F. in wildlife management; and he teaches biology, nature study, camp counselling, and conservation at San Jose State College in California.—En.



▲ EMANUEL SWEDENBORG, in 1719, favored a vast flood rather than ice as the moving force.

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▲ PETER DOBSON thought the parallel glacial striations were caused by stones in icebergs.



tremendous variety of boulders were found along the shore of Lake Superior, he visualized an earthquake, an eruption, or a flood, with Lake Superior as the source from which the water had flowed to deluge the earth. Ice was furthest from his thoughts.

In 1810, a Dr. Samuel Akerly explained the situation in New York State by visualizing the breaking of a huge, imaginary natural dam in the Catskill Mountains. Several others held similar theories. It remained for T. F. Jamieson, in 1862, to prove by admirable firsthand observation that a bursting dam could produce none of the effects so commonly found in glaciated country. After hurrying to the site of a burst dam, he found that the water had denuded the hillside in its path but that there were no glacial scratches parallel to the torrent. Indeed, he found real gla-

cial striations that ran nearly at right angles to the path of the water. The burst dam did not produce anything resembling the "drift," which we now know was produced by glacial action.

Icebergs and Glacial Drift

Several English geologists believed that drifting icebergs had transported and deposited the "glacial drift." A strong objection to this theory was that northern explorers had seldom seen rocks being carried on floating bergs. They said the process would have been far too slow to cause such vast deposits as were seen scattered over northern Europe.

It was a Connecticut millowner, Peter Dobson, whose lively imagination produced the suggestion that the parallel glacial scratches and grooves we now call striations were caused by stones embedded in the

undersides of icebergs. His statement gained him wide recognition, and even the celebrated American geologist James Dwight Dana gave Dobson's theory serious consideration. Dana concluded, however, that floating bergs could not have left scratches on such varied topography.

A Baltimore dentist, Dr. H. H. Hayden, tried to imagine the conditions that would cause a worldwide flood, with currents strong enough to transport rock materials. He suggested that the earth might suddenly have turned its northern pole toward the sun, causing a rapid melting of great quantities of polar ice. He pictured a flood of water rushing through Bering Strait between Alaska and Siberia. Another flood came down through the channel between northern Europe and Greenland. This great mass of water, he thought, must



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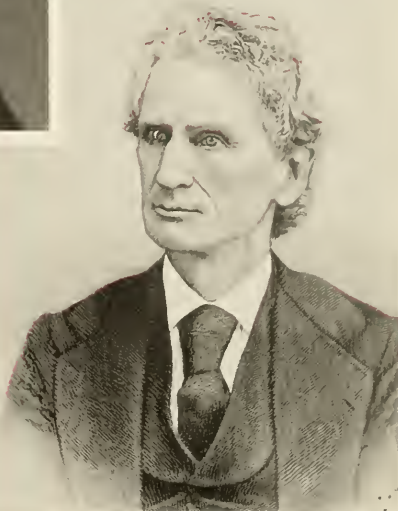


◀ LOUIS AGASSIZ championed the theory of continental glaciers and said the ice era occurred simultaneously in Europe and America.

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➤ JAMES DWIGHT DANA presented both the iceberg and glacier theories in his *Manual of Geology* but favored the correct glacial theory.

◀ SWISS GLACIERS like the Gorner Grät helped European geologists visualize continental ice masses.



have swept over northern North America. Labrador, where the water from Greenland and Baffin Bay would have struck the continent, he pointed out, had had its soil washed away.

Not all of those studying this puzzle were groping blindly. In countries where glaciers existed, people noticed that these "rivers of ice" moved and carried rock fragments. As early as 1723, a Swiss naturalist, J. J. Scheuchzer, mentioned the movement of glaciers and suggested that water filling crevasses in the ice and then freezing was the force that pushed the ice down the valley with its load of rock. We now know that ice can change its shape slowly under stress and that gravity is the force that moves a glacier. It was in 1802 that a man named Playfair asserted that glaciers moved down-valley because of their own tremendous

weight. He also pointed out that they carried rocks and dumped them at the melting front. Pointing to a boulder weighing 2520 pounds, he reasoned that it could only have been moved by ice and daringly speculated about glaciers of greater lengths. Gradually, principles that were found to operate in valley glaciers came to be applied to glaciers of continental size.

A Bold Idea

The year 1821 marked the beginning of the true glacial theory. J. Venetz, a Swiss civil engineer, observed that moraines — piles of rock deposited by glaciers—existed far below the present glaciers, and expressed his belief that the ice must once have extended to that distance. After discussing his theory with his friends, Venetz announced in 1829 that all of northern Europe had once been covered with ice!

This was a cataclysmic pronouncement.

Five years later, a friend of Venetz's named Jean de Charpentier, Director of Mines at Vaud, Switzerland, enlarged upon Venetz's views in a paper read in Lucerne. He pointed out that overhanging rocks had sometimes been scratched on the underside. The only explanation, he said, was a mass of moving ice conforming to each recess in the rock.

Several people were impressed with this theory. Not so, however, with J. A. de Luc, who said that "de Charpentier would have done better to leave his imagination out of it and not create glaciers that would present the Supreme Being with a problem in having to melt them."

Louis Agassiz, the noted zoologist, frankly doubted de Charpentier's concept at first. But he visited

continued on page 110



THE JUMP IN THE *Jumping Bean*

These natural curiosities from Mexico entertain young and old, but few realize that their secret is one of nature's tricks for beating the heat

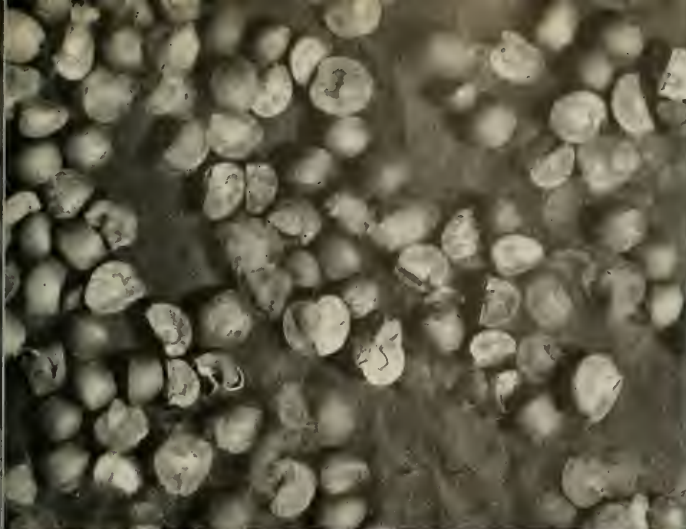
By ROSS E. HUTCHINS*

ALMOST everyone has seen Mexican jumping beans. They are often sold in novelty shops and other places and are frequently displayed in show windows, because their jitterbug movements attract attention. Yet, as is often the case in the world of nature, the story behind these curiosities is much more interesting than the mere fact that the beans appear to be endowed with a mysterious ability to hop about.

As far as modern scientific records are concerned, the story be-

gan in 1857 when the insect that puts the jump in the jumping bean was first described and named in the Proceedings of the Ashmolean Society of Oxford, England. The insect has had its name changed several times in the intervening years, having been at different times placed in the genera *Laspeyresia* and *Carpocapsa*. However, the presently accepted name is *Laspeyresia saltitans*. The insect is a close relative of the common apple worm, and there may be more than one species involved.

The plant that produces the bean was first described by botanists about this same time. It is called *Sebastiania Pringlei*. The plants of the genus *Sebastiania* are tropical shrubs that belong to the Euphorbiaceae, or spurge group of plants. You are no doubt familiar with such common spurges as Poinsettia and snow-on-the-mountain. In Mexico, the jumping bean plant is called *yerba de flecha* ("arrow plant"), because its milky, poisonous sap was once used as an arrow poison. It has also been used as a



IN MEXICO, they are known as *brin-
ores* — "leapers." The heat of the
d generally stimulates them into
ter activity.

▲ A MULTIPLE-EXPO-
SURE PHOTOGRAPH
showing how the
"beans" hop about.

▲ THIS is the moth that laid the egg that
made the caterpillar that put the jump in
the jumping "bean." This insect is a close
relative of the common "apple worm," or
codling moth.

fish poison. If one stirs his coffee
or any other drink with a small
twig of the plant, the sap is said to
act as a strong cathartic.

This interesting shrub grows in
the region of the Rio Mayo in
southern Sonora and Chihuahua,
where it thrives in the barrancas
and arroyos. It grows up to about
five feet and bears shiny, lance-
shaped leaves. The flower spikes
appear in early summer when rain
comes to this arid land.

It is probably about this time
that the adult moth deposits its
eggs in the developing seed pods,
though not much is known about
the insect's life history. The seed
pods mature by late summer.

As if there were not already
enough of interest about this plant,
Nature has added another touch.
When the three-parted seed pods
are fully developed and dry, they
snap open and the seeds can be

heard hurtling through the dry
brush like BB shot. This serves to
disperse the plants to new locations.

Certain of the pods, however, do
not rupture and toss their seeds,
for the simple reason that there are
no seeds to toss. The eggs that were
laid by the moth in the developing
ovaries of the plant hatched into
small caterpillars that consumed
the entire contents of the pods.
These pods or beans merely drop
to the ground, where they begin
their careers as "jumpers."

But this is still not the end of the
story; in fact, it is really just the
beginning, as far as the jumping
beans are concerned.

After the beans with the caterpil-
lars inside fall off of the plant, there
are two things that may happen to
them. The first is the natural and
more usual sequence of events; the
second occurs only with the entry
of man into the story. Let us con-

sider the natural course of events.

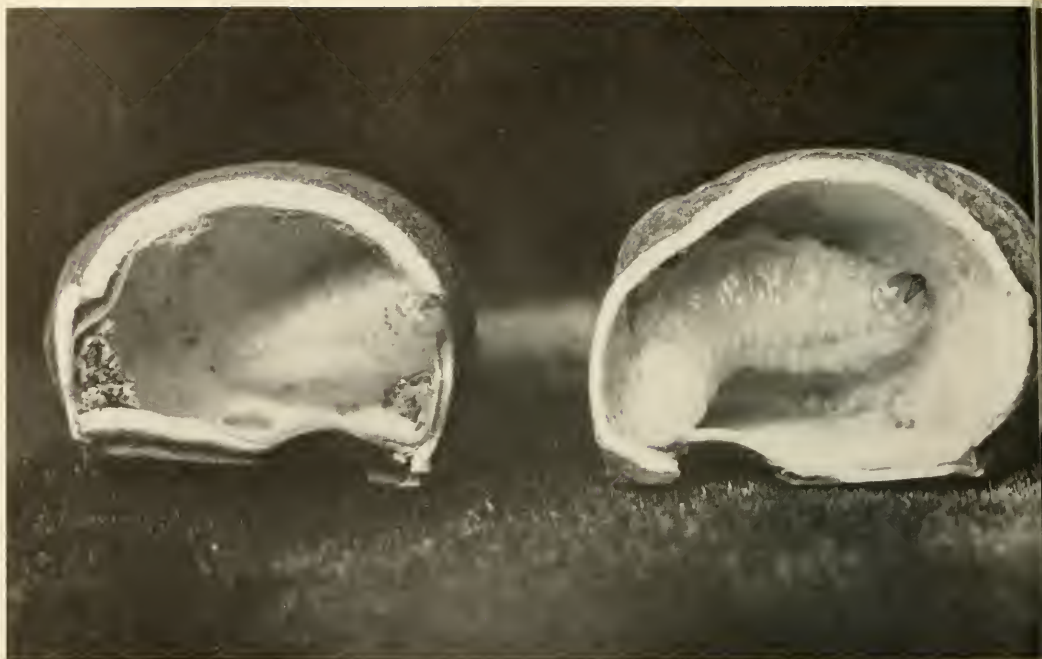
The beans drop upon the barren,
rocky soil, which is parched by the
subtropical sun. The sparse vegeta-
tion offers little shade, and the
temperature at the earth's surface
climbs rapidly at midday. The
beans would soon become so hot
that the enclosed larval insect would
be killed. So what does the insect do?

The caterpillar has already lined
the walls of its cell with silk, and,
as the rising heat stimulates it, it
grasps the silken wall with its legs
and snaps its body. This causes the
bean to jump or move a little. The
hotter the temperature, the more
vigorously does the little creature
jerk its house about. It's pretty
much a hit-and-miss proposition as
to where the bean will end up, but
the chances are good that it will
land in some crevice where it will
be protected from both birds and
desert heat. Incidentally, the cater-
pillar weighs about as much as the
shell of the bean enclosing it, so it
has sufficient momentum to carry it-
self some distance, perhaps even
for several inches in one hop.

It is amazing how much energy
is contained in the tiny caterpillar.

*ROSS E. HUTCHINS became interested
in the adaptation of animals to extreme
conditions while ranging the frigid 6000-
foot elevations around the cattle ranch
on which he grew up near Yellowstone
Park. He secured his Ph.D. from Iowa
State College at Ames and has been a
professional zoologist and entomologist in

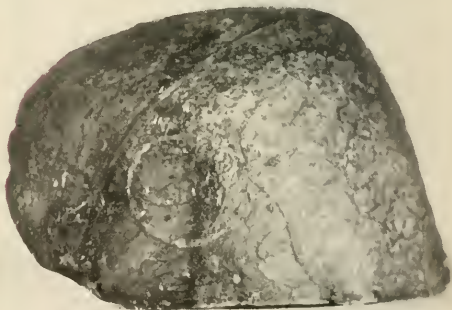
the South for over 20 years. During World
War II, he served in the Medical Corps
of the Navy. "While living for a year in
a tent at Pago Bay on Guam," he says, "I
did little to further the war effort, but I
learned much about the fantastic realm
of life on a tropical coral reef." He writes
frequently for NATURAL HISTORY.—ED.



▲ THE SIDES of two "beans" have been cut away here to show the small caterpillars that put the hop in the jumping "beans." The silken lining of the shell that the insect grasps when it snaps its body can be seen.



▼ CLOSE-UP of a "bean" showing where the caterpillar has partly cut through the exit door from the inside. Months later, the pupa will push this hatch open and emerge as an adult moth.



◀ BINGO WITH BEANS: One of several games of chance utilizing jumping beans as pawns.

It lives in the bean for about six months and will continue to jump, especially if heat reaches it.

After a few months, the caterpillar cuts a circular door in the end of the bean, but the door is not cut all the way through and the lid remains in place. The caterpillar then changes into the pupal state, in which it remains until spring. The cutting of this escape hatch is rather amazing when one considers that the caterpillar can have no foreknowledge of its use, and will itself never use it. But it is an instinctive act and a part of the chain

of events that occur in the life of the insect.

When spring comes once more to the land of cactus and thorn trees, the *yerba de flecha* again puts forth its blossoms. Now the pupa inside each jumping bean becomes active and pushes out through the prepared door. The back of each pupa splits open, and out crawls a tiny moth that soon mates and flies away to lay its eggs in the developing seed pods of the host plant. And so the yearly cycle is renewed.

However, another fate—an unnatural one—may overtake the *brincador*

that falls from the *yerba de flecha*. In certain areas, young men and boys collect these curiosities in great numbers and sell them to local buyers, who in turn export them to the United States. There they become objects of wonder and amazement. Games of chance have even been devised in which the unsuspecting *brincadores* are used as the pawns.

The fate of the caterpillar in the exported jumping bean is gloomy, though. Since it cannot find its host plant outside its native land, it cannot perpetuate itself.



◀ THIS *brincador* was cut open after the caterpillar had transformed to the pupal state. The pupa is now surrounded by a silken cocoon.

▼ WHEN SPRING comes to the arid region of southern Sonora and Chihuahua, the pupa pushes open its door.



▲ Soon a tiny adult moth will break out of the pupal case. When it finds a mate, eggs will again be laid in the developing seed pods of the "arrowplant," and the strange cycle will begin again.

➤ AN EMPTY SEED POD, abandoned by its insect after many months of occupancy.



The news about the attack interrupted the rituals. All the Indians came to the hut where I was lying and showed me serious faces. The strongest reaction came from Atukaré. This was the Indian who, as described in the earlier article, had pointed his knife down on my shoulder when I gave him only a knife and no ax at the ceremony of greeting. Now he vowed that he would shoot Kupo with his bow!

"Oh, no, Atukaré," I said. "That would make no sense. Please go to my house and bring me my hammock and my gun."

I was feeling so badly that I was

sure I should die unless help could be procured from the Indian agency, *Fraternidade Indígena*. "Look what Kupo has done to me," I said to Jukupá. "Do you think I am going to die?"

Jukupá nodded his head and grunted something incomprehensible. Then he said: "Yes, you will die, Haroldo." But he would not leave at night for the Post. These Indians were afraid to travel by night because of poisonous snakes.

I was still losing some blood and was afraid that time should go too fast. But they would only say, "Not today, tomorrow."

When they tied my hammock up in the house, I tried to climb into it, but the world disappeared and I knew absolutely nothing more.

Would Kupo Return?

I awakened when it was dark and was still lying on the straw mat. They had made a pillow of bark. The Indians were gone. Two fires were burning on the ground.

When I moved a little, Mitoponepa jumped from his bed and said: "May I help you? What do you need?"

With his assistance I was able to get into my hammock, but I could not sleep. I kept thinking of Kupo's promise to return and kill me. Each little noise scared me. Whenever a cricket walked on the straw roof or a lizard fell to the ground, I would think: "Now, this must be Kupo."

But Kupo did not come, and in the early morning his wife was again the Good Samaritan, anointing my wounds with medicinal herbs.

"Where are the ones I told to go for help?" I asked.


She answered: "Atukaré and Julaparé started to the Indian Post yesterday while you were dead." (The Umutinas have the same word for illness and death. If they want to imply that there is no hope, that the person is really dead or already buried, they add the word *motó*, meaning earth and signifying "dead and already buried." They used this

form in referring to me, because they considered me quite dead. Indeed, the two messengers used the same word in reporting the situation to the Indian Post, and the agent sent a wire to Rio de Janeiro announcing that I had been assassinated by the Umutinas.)

Help came quickly. My good friend José Ferdélis, the agent of the Indian Service, led a group of more than a dozen civilized Indians, well armed with guns, jungle knives, and other weapons. They had expected a hostile reception.

They started carrying me out the same day they arrived. A long pole had been cut, and my hammock was tied to it. Two men carried this on their shoulders, relaying when they became tired. I expected to suffer considerably during the trip, but the others carefully cut all the branches that might hurt me, and nothing bad happened. We had to cross 50 miles of jungle, swamp, and open savannah, but I was not even scratched by a thorn.

All in all, it was a most unpleasant experience, except for the kindness of the Indians who took care of me. People say that I must have the spirit of a cat to have lived through this. It was a close call. As for Kupo, he is still living at the Indian Post on the Upper Paraguay River, with his wife and children. He was the unfortunate example of a marginal Indian — one who had entered that difficult realm half-way between the world of the white man and the world of the Indian. In addition to having lost his father and uncle at the hands of the white man, he had early in life been banished from his tribe for having married his cousin, which is taboo among the Umutinas. He had had a little taste of civilization and had grown to resent its destructive effect on the native culture. He was resentful toward the white man's bullets and diseases, and he took it out on me. I think I can understand how he felt. And if I had not lost my temper, I might never have been "almost murdered."



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By GEORGE FORREST

Photographs by DON SHINER

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▲ Ponderous elephant feet of every size are found among the iceland toys.

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▼ Ribbons, bows, and icy popcorn strings glitter and sway in the winter wind.





Letters

Cats and Witches

Sms:

... In his article, "Majesty in a Fur Coat," Mr. Webster does not allude to two former Scottish customs involving cats. One was the throwing of a cat into the sea by witches to raise a storm. There was a famous trial connected with this in 1590, as recounted in Dr. Margaret Murray's *The Witch Cult in Western Europe*. The other was the roasting of a live cat on a spit for purposes of divination. This latter was described (though not at first hand) by Martin Martin in his book on the Western Islands of Scotland, written in the last decade of the seventeenth century. According to his account, when this was done "a very big Cat comes, attended by a number of lesser Cats, desiring to relieve the Cat turn'd upon the Spit, and then answers the Question." This was a third method of divination, only resorted to when two other methods had failed, so it was probably not very frequent.

One does not need to go to Scotland to find witches appearing in the form of cats. At the trial of the Salem witches in 1692, Sarah Carrier, aged 8, described how her mother came to her in the form of a black

cat (Winfield S. Nevins, *Witchcraft in Salem Village in 1692*, p. 185.)

J. L. CAMPBELL
Isle of Canna, Scotland

President of the
Folklore Institute
of Scotland

Zoo 'Roos

Sms:

In his article on Australian tree kangaroos in the December issue, John Sidney makes the statement that unless these animals are provided with their natural diet, the reader probably won't see them in the local zoo. He also states that they don't live long in captivity. This pessimistic viewpoint may be altered when he learns that the Chicago Zoological Park, Brookfield, Ill., has a pair of Matschie tree kangaroos from New Guinea which are still living after a residence of six years. Their diet includes corn, rolled oats, grains, alfalfa, carrots, apples, sweet potatoes, grapes, and bananas — obviously not a natural diet.

ALEXANDER LINDSAY
Brookfield, Ill.
*Answer Man
Brookfield Zoo*

Tule Springs — Its Date and Its Fate

Sms:

Dr. Harrington's article, "Man's Oldest

▲ AN UNUSUAL PORTRAIT of a flying squirrek showing its wide nocturnal eyes and sensitive nostril hairs, or vibrissae. By John H. Gerard.

Date in America" in your December issue is very instructive in placing man here 23,800 years ago — though Biblical and secular history and chronology plainly show that the Flood was less than 4500 years ago, with the Babel dispersion more than 100 years after that.

You scientists ably show that man is smarter than God, giving God blame for a miserable beginning, and giving man credit for a glorious development.

You may know the age of the rocks — but know little of the Rock of Ages.

ROY HOLLIDAY
Coon Rapids, Iowa.

Sms:

Dr. Mark R. Harrington's very informative and well-written article, "Man's Oldest Date in America," ... was of especial interest to me, for I took occasion to visit the Tule Springs site near Las Vegas, Nevada, in 1943 and 1944 while I was stationed at the Las Vegas Army Air Force Base. At that time I remembered reading Dr. Simpson's paper on the Nevada Pleistocene fauna, and had already visited Gypsum Cave on the strength of Dr. Harrington's fascinating descriptions of it ...

On one of my visits, to Tule Springs, Dr. Richard Cassell, a dentist by profession and a free-lance photographer by avocation, accompanied me and took several pictures of the exposed mammoth tasks, one or two of which appeared in *NATURAL HISTORY* in November, 1945.

Knowing the tremendous value of the site . . . I did not permit any of our group to molest this part of the wash in any way. Visits to Tule Spring were one of my most treasured experiences in the Western

BOOKS *continued from page 63*

gola, the author proceeds by logical stages downstream, describing the environmental features of each natural area and then dealing with the peoples, past and present, who live along the river. In some respects, it is difficult to remain oriented with the river because these digressions plunge the reader into the philosophy, if such it is, of human relationships. As Tennyson reminds us, the coming and going of man is transitory compared to the eternity of flowing water. And so the reader will do well to maintain two channels of thought in reading this book—one to stay with the leisurely river and have little emotional disturbance, the other to analyze and explore the anthropological data so ably presented and to expect emotional reactions.

As one who has seen a fair amount of this area from the air and had some closer contact on the ground, this reviewer finds Macdonald's presentation fair and unbiased and his text factually sound. He is careful to give both sides, he appreciates the difficulties, and makes allowances for human nature. But he also makes clear the very real difficulties that arise when cultures centuries apart are mingled in an area as undeveloped as that of the Zambesi.

HAROLD E. ANTHONY.

200 MILES UP
----- by Gordon Vaeth
Ronald Press, \$5.00
261 pp., 77 illus.

THE Second Edition of *200 Miles Up* is a timely and lively amplification of the earlier issue of the same book printed in 1951. For those who prefer their accounts of rocketry and upper-air research unadulterated by fancy or futurism, this is an essential component of a complete library collection. Nor does telling the facts straight in any way detract from the interest or excitement of the subject.

Originally, the book related the history of American upper-air research—the instruments used, the methods employed, and the upper air vehicles that accomplished the missions of new knowledge. The V-2, the Aerobee, and the Viking each have a chapter devoted to them, and

United States, and they became even more memorable . . . upon learning that this site places man in America more than 23,800 years ago.

Perhaps it would be difficult to accomplish, but it seems to me that an area of such great archeological importance should in some way be protected from possible vandalism . . .

DONALD J. ZINN
Associate Professor of Zoology
University of Rhode Island,
Kingston, R. I.

the other rockets and sounding balloons that have made significant contributions are also included.

The earlier edition ended with a chapter on the Viking Rocket. At that time, Viking's achievements represented the frontier of upper-air exploration, and the Viking still holds the record for single stage altitude (at 158 miles). New developments have been announced in the intervening years, however, and the last three chapters of the new book, entitled "The Future and the Upper Air," "The Minimum Satellite," and "Beyond the Earth," make *200 Miles Up* as nearly current as security restrictions permit.

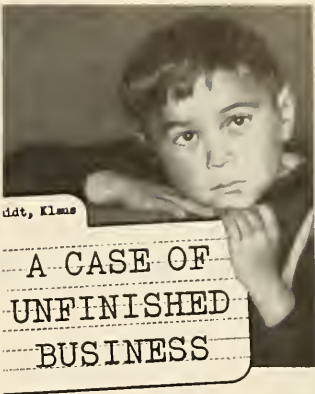
On July 29, 1955, the President of the United States announced that the United States, as part of its contribution to the International Geophysical Year (1957-58), would attempt to launch an artificial earth satellite. Mr. Vaeth has described with especial competence the device itself and the objectives to which it will be assigned. His position as Head of the Weapons and Systems Division of the U. S. Navy Special Devices Center, Office of Naval Research, should give assurance that he speaks from firsthand knowledge.

JOSEPH M. CHAMBERLAIN

MA-KA-TAI-ME-SHE-KIA-KIA: BLACK HAWK;
AN AUTOBIOGRAPHY
----- edited by Donald Jackson

University of Illinois Press,
Urbana, Ill., \$3.75
206 pp., 22 illust., 2 maps.

THE autobiography of Black Hawk, the famous Sauk Indian warrior, was dictated to a government interpreter, edited by a young Illinois newspaperman, and first published in 1833. Since that time it has generally been counted an American classic, even though there has been some speculation as to the degree to which Antoine LeClaire, the interpreter, and J. B. Patterson, the newsman, distorted Black Hawk's original statements. The editor of the present edition, Mr. Donald Jackson, believes the autobiography to be an authentic document, and he is in the best position to judge. Many documents relating to Black Hawk's period have re-



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cently become available, and Mr. Jackson has put them to good use. His numerous notes based on them illuminate and amplify Black Hawk's original narrative.

Black Hawk probably saw more American expansion than any Indian who ever lived. Unlike his fellow tribesman, Keokuk, who preached a policy of peaceful co-existence with the Whites, Black Hawk fought savagely to the last ditch. But while Black Hawk's story is a tragic tale of his futile battle for survival, it is also a chronicle of American history from an Indian's point of view. During his 70-year lifetime, Black Hawk lived under four flags. He fought armies whose members included Abraham Lincoln, Jefferson Davis, and Zachary Taylor. He knew such greats of his day as George Catlin, Henry Schoolcraft, and Andrew Jackson. Black Hawk's autobiography is a generous slice of Americana.

Some comment must be made on the

format of his book. Most university press productions have all the zip and dash of a telephone directory. *Black Hawk*, designed by Ralph Eckerstrom, is as pleasing and stylish in its imaginative layout and modern typography as anything produced by a commercial publishing house. It is something of a landmark, and the University of Illinois Press is to be congratulated.

HARRY TSCHOPIK, JR.

Recordings

THE PUEBLO INDIANS IN STORY, SONG, AND DANCE ----- Music by Swift Eagle

Description by Charles Gallenkamp
Soundbook CS 105, \$5.00

FOR anyone, child or adult, desiring to hear authentic American Indian music, this album is an excellent, though brief,

introduction. It consists of a ten-inch 33 $\frac{1}{3}$ r.p.m. record accompanied by an intelligent and informative text, charmingly illustrated by the Indian artist, Yeffe Kimball.

One side of the record is a legend, "The Bear Boy," narrated by a Pueblo Indian, Swift Eagle. I found his accent objectionable, but my children enjoyed the story. The other side, however, is very good indeed. While the singer in all cases is Swift Eagle, he sings, like most Pueblo Indians, in the manner of neighboring tribesmen as well. Thus, while "The Laughing Horse" is sung in the serious, measured style of the eastern Pueblos of New Mexico, "Hunting the Fox" is rendered in the unearthly falsetto of the Navaho, and "The Buffalo Dance" in the exciting, rapid style of the Sioux. The other selections, which provide background music for "The Bear Boy," are all typical Pueblo melodies.

HARRY TSCHOPIK, JR.

THE GLACIAL CONCEPT IS BORN *continued from page 101*

de Charpentier in 1836, and the two of them went to examine a Swiss glacier. Agassiz thereupon not only agreed with de Charpentier but felt his theory had not been carried far enough. He became one of the foremost glacial geologists of his time.

The following year, in an address to the Helvetic Society, Agassiz explained his Ice Age concept, stating that ice once extended from the North Pole to the Alps. He also thought that the mean temperature of the earth was lower during the Ice Age. In a book he published,

Agassiz theorized that the peaks of the Alps were thrust up through the ice, breaking the rock into smaller particles, which fell onto the ice and were then carried away. He included in his book the theories of Venetz and de Charpentier. However, de Charpentier was preparing a paper of his own at that time and was so enraged by Agassiz's breach of propriety in jumping the gun that he terminated their friendship.

In 1846, Louis Agassiz came to America to become a professor at Harvard University. Here he applied his glacial theory to nearly everything he saw. After surveying the Lake Superior region, he was convinced that "glacial drift" was due to a great ice sheet. The drift deposits, he concluded, would not terminate so abruptly near the 39th parallel in that vicinity if water had been the transporting agent. He also asserted that the glacial epoch had occurred in Europe at the same time as in America. This was a brilliant conclusion; and it was verified over a century later by the Carbon 14 method of dating.

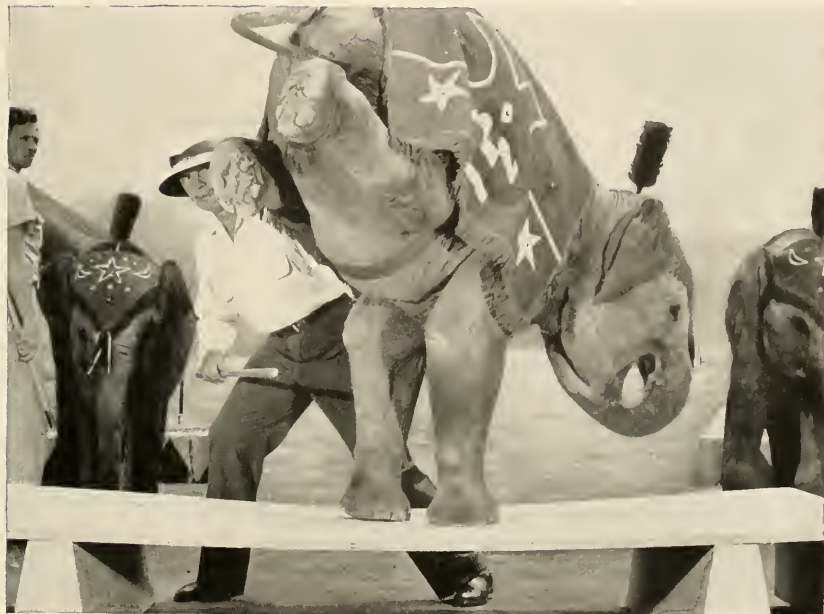
Attention began to focus on Greenland, an immense ice-covered



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island. It was noted that the ice accumulated in the interior and flowed radially to the sea. T. F. Jamieson, who had observed the burst dam, now conceived of heavy masses of ice covering Europe, even where there were mountain peaks of 1200 feet or more. Floating ice in the arctic, he pointed out, drifts aimlessly about and could not produce parallel striations on rock. He thought that the climate in the Ice Age was more humid and colder. Arctic shells were found in sunny Sicily. Old shore lines far above the present levels of salt lakes in Asia also bore out the theory that the climate was once wetter.

Numerous other theories were advanced, few of which aided in the laborious birth of the idea known as the glacial concept. Stubborn Josiah Whitney, first State Geologist of California, exchanged verbal blows with the famed naturalist John Muir concerning the origin of Yosemite Valley. Whitney,



who earlier admitted to glacial deposits on the floor of the valley, later claimed that the glacial theory as applied to Yosemite was absurd. The powers of flowing ice, he stated, had been greatly exaggerated.

Timothy Conrad, a paleontolo-

gist, tried to account for the origin of glacier ice by imagining numerous frozen lakes being lifted up during a land upheaval. The ice in the lakes, he reasoned, then slid downward, carrying with it sand and gravel.

By 1880, the glacial concept was brought well on its way to universal understanding when James Dwight Dana, in his *Manual of Geology*, presented the pros and cons of the two remaining theories of drift deposits—icebergs and glaciers. His beliefs were slanted strongly in favor of the glacial theory. He noted alpine plants in North America whose location could be accounted for only by a cold Ice Age climate. Snow and ice, he said, could accumulate in northern centers and pile so deeply that it could cover the land, flowing across valleys and over low mountains and hills.

As the glacial concept grew, it shook off the remaining opposition, but some die-hards held on into the twentieth century. Today, the finer points of glaciation are continually being elaborated. And as this body of knowledge grows, our minds expand to embrace in greater detail the era when continental masses of ice covered nearly a third of the earth's land surface, greatly modifying the climate and influencing life for the early races of man who lived within its shadow.

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| 5. Just Call Me Lonesome | 14. I'm a Little Bit |
| 6. Yellow Rose of Texas | 15. There She Goes |
| 7. If You Were My | 16. Goodbye, You Know What |
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STOP SAYING "I CAN'T AFFORD TO RETIRE"

By **NORMAN D. FORD**

author, *"Where to Retire on a Small Income"*, *"How to Earn an Income While Retired"*, *"Norman Ford's Florida"*, founder of the Globetrotters Club

IF THERE is anything I have found out in traveling up and down this country it is that it costs less to retire than you may think it does—provided you know where to retire.

As founder of the Globetrotters Club, I made it my business to discover low cost beauty spots all over the world. And I also learned that right here in the U.S. there are hundreds of undiscovered towns, islands, and bigger communities which are just right for the man or woman who wants to retire now and has only a small amount of money. Here are just a few of them.

Do You Know Where to Find These Best Retirement Values in the U. S.?

If You Like an Island

Which is the New England find of the year? That wonderful Maine island which is not only a retirement center because living costs are so low they attract many who otherwise could not afford to retire, but a real find in New England towns, for it's 10-15 degrees warmer here in winter than on the mainland (and 10-15 degrees cooler in summer)?

Which is the town for the lucky few? "You sent me to the perfect island," a woman wrote me. "This island is so perfect, take it out of your book and let's keep it for the lucky few." Plenty of seafood here for the picking. Vegetables grown all year round. Warm winters due to nearby Gulf Stream. Low building costs; you can erect your 3-5 room cottage for \$3500-\$5000.

Do You Prefer the Theatre and Music?

Which town do people call the most "cultural" small town in all America? It's a friendly town in North Carolina with a cosmopolitan retired population. Cool summers (1500 feet high), warm winters, Little Theatre, art and music club, library, TV. Or consider that wonderful mountain health spa, farther west, completely surrounded by a national park. A grand recreation centre for every type of sport and pastime, where there's something to do every single day of the year.

What About Florida?

Where do you get the most sunshine in Florida, the friendliest towns, the lowest prices? Which is the still unknown section, where you can still buy Florida property at reasonable prices? Where do you find the best chances to pick up extra income? Which are the best Florida communities if you want a job with a future or a business of your own? Which are the best towns for a short vacation or a few

weeks' rest? What's the one easy way to cut your vacation costs in the town you choose?

Do You Prefer the Southwest?

Do you know the favorite retirement spot in all the Southwest for those who like a Little Theatre, art galleries, etc.? In which Southwestern town does the sun actually shine 85% of all daylight hours? Which is the best town in Texas if you want plenty to do and cool summers? Can you find low, low prices anywhere in Arizona or New Mexico?

or America's Pacific Coast?

Which is the most beautiful town in all California? Nothing has been allowed to detract from the beauty of this landscaped hillside community with its Old World appearances. Prices high, but better bargains available nearby.

Where can you find the most healthful climate in the world? University experts name a town in Washington State. It lies in a unique dry belt, where there are green fields most of the year. Army, Navy, and seafaring men have found it already and retire here on a small pension. Golf, tennis, bowling, fishing, hunting, boating, TV. Many part time jobs. Of course, these are only a handful of the hundreds of beauty spots, hideaways, and larger communities in the U.S., where you can retire now on little money and enjoy yourself completely. The best of them are described in *Where to Retire on a Small Income*. And while this book has a chapter on Florida, if you're thinking of Florida, get *Norman Ford's Florida* as well. It's a big complete guide to everything you seek in this big state. Both books are described below and in the column to the right.

WHERE TO RETIRE ON A SMALL INCOME

THIS book selects out of the hundreds of thousands of communities in the U.S. and its island territories only those places where living costs are less, where the surroundings are pleasant, and where nature and the community get together to guarantee a good time from fishing, boating, gardening, concerts, or the like. The book never overlooks the fact that some people must get part-time or seasonal work to pad out their incomes.

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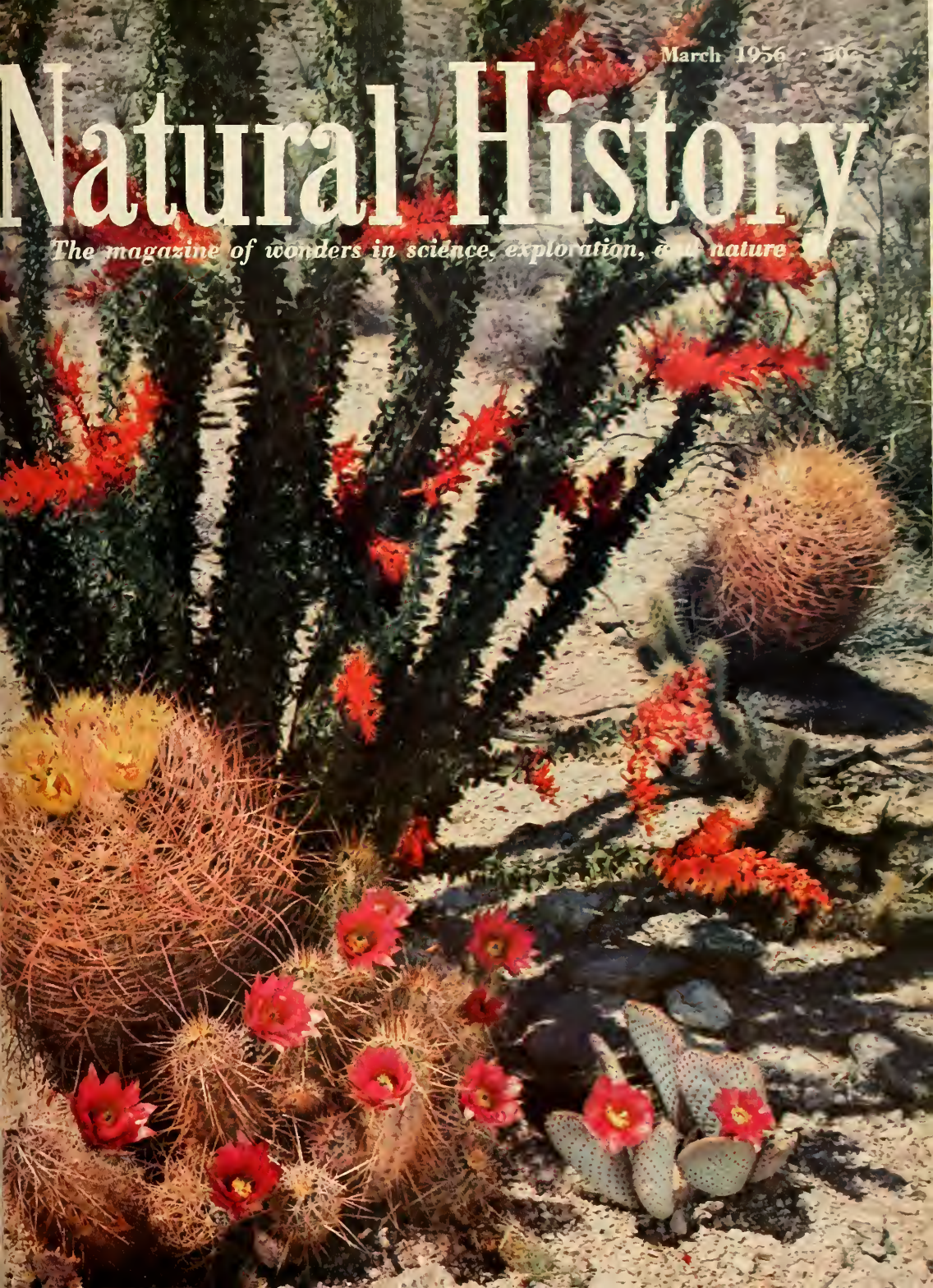
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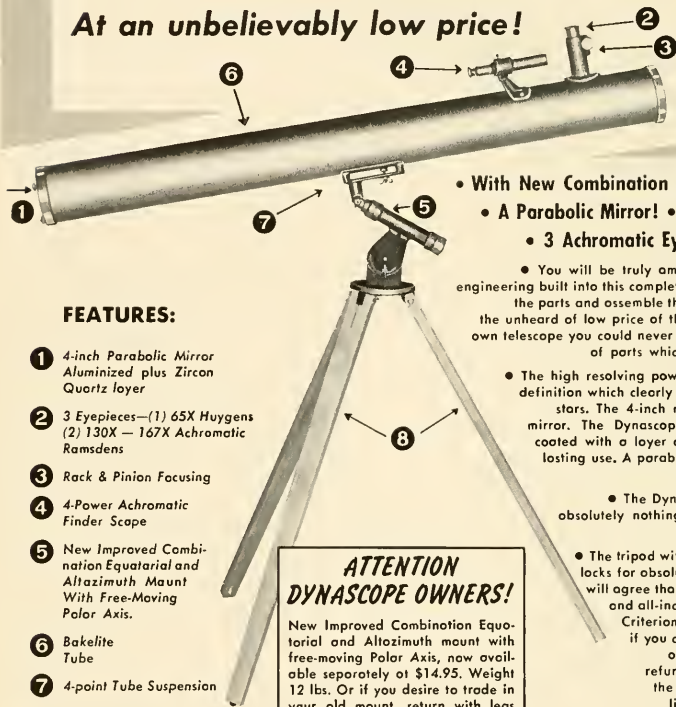
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March, 1956 Volume LXV, No. 3

Desert Blossoms Cover Design

From a color transparency by Josef Muench

Your New Books 117

Stone Age Artists of Mililingimbi Lyn Harrington 120

A friendly visit among the Aborigines of Arnhem Land, who are retaining the best in their culture under a plan of government help

The Alaskan Snow Flea Carleton Ray 128

Its adjustment to life on and in a glacier is so extraordinary that science can as yet only guess how it reproduces the next generation

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Sired by a jackass—with a horse for a mother—unable to propagate himself—this rugged individualist has helped promote an economic evolution that has left him jobless

The Mystery of the Mima Mounds Howard E. Jackson 136

After more than a century of controversial theorizing, their anonymous architect proves to have been neither man, fish, nor animal

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Never were wild creatures friendlier than in this symphony of mutual curiosity on one of the least disturbed islands in the tropics

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He carries the eggs in his mouth until they hatch; and if males are absent at mating time, one female will court another

Two Weeks in Father's Mouth Evelyn Shaw 152

The camera catches Tilapia in its dramatic change from egg to young fish

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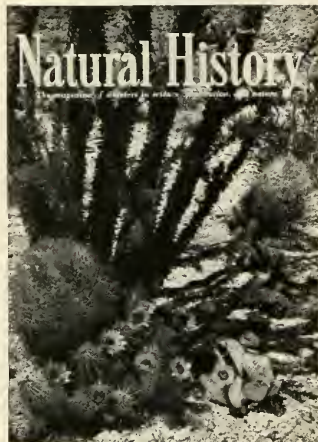
The story of what are believed to be the oldest skeletal remains yet discovered in North or South America

The Vine that Wouldn't Stop Growing Aubrey B. Haines 159

This veritable Jack-and-the-beanstalk among Wistaria has already smothered one ten-room house and is clutching at another in its march to fame as one of the horticultural wonders of the world

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THE COVER THIS MONTH

The dark green leaves of the ocotillo form an attractive background for a profusion of brilliantly colored spring wildflowers in our southwestern deserts. During periods of drought, the ocotillo sheds its leaves, but shortly after the first good rain, its branches are reclothed.

The cylindrical stems of the barrel cactus, crowned by yellow flowers, are occasionally hollowed out by wood rats in their quest for food and water. Before it, in the left foreground, is the hedgehog cactus. Its stems are sometimes so densely covered by spines that their surfaces are completely hidden.

The heavertail, in the right foreground, is a cactus without spines, but it is not defenseless. Its stems are studded with prickly hairs that are irritating to the skin.

This artistic arrangement is a striking example of the variety of color and form that carpets the desert floor in the springtime.

This striking photograph was taken by Josef Muench.

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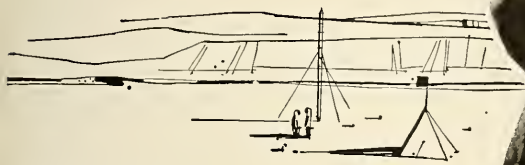
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FORTY-FOUR years ago two sledge parties reached the South Pole. One, led by Captain Roald Amundsen from Norway, returned safely to its base near the edge of the Antarctic Continent; the other, led by Captain Robert F. Scott from Great Britain, perished to a man far out on the blizzard-swept ice.

The last person to see the Scott party alive was Teddy Evans, a young naval officer who led the final supporting team. After a terrible return journey he was invalided home critically ill with scurvy. On recovering, he began a dramatically successful career in the Royal Navy, culminating in his retirement as an Admiral and with the title Lord Mountevans, taken from an antarctic peak Scott had named for him. In his new-found leisure the old explorer now returns to the antarctic, his first love, since as he writes "...there is nothing of which I am so proud as the fact that once—long ago—I was captain of the *Terra Nova* and second in command to Robert Falcon Scott."

Lord Mountevans has written in *The Antarctic Challenged* an unpretentious and in every way admirable outline of the history of antarctic exploration. In sixteen chapters he carries the story from Magellan's voyage around Cape Horn down to the Norwegian-Swedish-British expedition of 1952. Despite his personal background he is eminently fair to the explorers of other lands and clearly has little use for the nationalist rivalries that have arisen in recent years. His characteristic impartiality is nowhere better shown than in the description of Amundsen's race to the South Pole and in the generous account of the part played by Dr. Frederick A. Cook on the "Belgica" expedition. Perhaps the most commendable aspect of this well-written book is the light of experience the author continually throws on events, whether they are aboard a whaler jammed in the pack-ice, or surround the predicament of

an explorer suspended part way down an immense ice crevasse. Great though his admiration may be for the old-time sailor-explorers, Lord Mountevans also respects the modern pioneers who revisit the old haunts by means of ice-breaker, airplane, and tractor.

In the next few years the old challenge to Antarctica is to be repeated on an immense scale, thanks to the many expeditions that will probe its secrets during the forthcoming International Geophysical Year, 1957-58. Lord Mountevans' book will provide an excellent background for anyone trying to follow the news reports intelligently, and it should be required reading for the thousands of tenderfoots who, in one way or another, will find themselves directly or indirectly concerned in the vast operations down-under.

TREVOR LLOYD

INDIANS OF THE NORTHWEST COAST

— by Philip Drucker

Anthropological Handbook Number 10.

Published for
The American Museum of
Natural History

by McGraw-Hill Book Co., \$5.75
208 pp., 104 illus.

THIS book contains the best and most complete summary of Northwest Coast Indian life that I have ever seen.

All important aspects of aboriginal Northwest Coast culture are presented topically under the following headings: the land, the people, prehistory, physical anthropology, history of European contacts, economy, material culture, society, religion, ceremonies, the cycle of life, art, subareas, and cultural relationships.

For a summary or synthesis, the details are remarkably complete. Here, perhaps for the first time, is presented a feasible account of how to use a halibut hook. All previous descriptions of halibut fishing that I have read have been either inadequate or impossible, an unusual situation in view of the many years of study and many descriptions of Northwest Coast tribes. On the other hand, I would have ap-

preciated some additional information in the chapter on ceremonies, considering the complexity and wealth of available detail on the subject. The rare photograph of a ceremonial (Fig. 79), the source of which is not identified, is a still picture from an almost unknown movie of the southern Kwakiutl made between 1910 and 1914 by or for Edward S. Curtis.

Speculating on the origins of Northwest Coast civilization, Dr. Drucker reaches the interesting conclusions that it was derived from ancient Eskimo cultural patterns that had been modified and adapted to the milder and richer environment of the Northwest Coast. The resultant pattern was further modified, enriched, and elaborated by the ancestors of the Salishan tribes and the Tlingit, Haida, and Tsimshian who came to the coast from the interior. The Asiatic influences in Northwest Coast culture were transmitted by Eskimo and Aleut or else formed a part of the ancestral cultural base.

This book will be useful not only to anthropologists and students but also to those who desire some background for the appreciation of Northwest Coast art or who simply would like to be introduced to the most unusual Indians in North America. I recommend this book highly.

GEORGE I. QUIMBY

THE HURRICANE HUNTERS

— by Ivan Ray Tannehill

Dodd, Mead & Co., \$3.00
271 pp., 28 illus.

MOST of us have experienced hurricanes, feeling their splendor as well as their horror. Mr. Tannehill gives one an understanding of them as well as of the history of the study leading to increasing control of their destructive force.

No two hurricanes are alike, he repeats throughout the book. Yet he presents a general form which is helpful to the public as well as to the hunters. By their very repetition, the many graphic descriptions of the eyes of hurricanes give the reader a never-to-be-forgotten

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Indians of the Plains

by Robert H. Lowie. This is the first volume in a series of anthropological handbooks published for the American Museum of Natural History. It is a vivid recreation of the life of the Plains Indians who figured so largely in our history. Included are the Dakota, Crow, Blackfoot, Cheyenne, Plains Cree, the Kiowa, Mandan, and the Ute tribes, from the time of their discovery to today. 100 drawings, photos, maps. 207 pages.

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The American Museum of Natural History, New York 24, New York

picture, as if he himself had been within such eyes. This same effect holds, too, for the power of the winds, which rush and scream in violence in their planned spirals, and of the seas below, raised mountainously and broken violently, or scooped out far below their normal surface.

A son of a sailor named Redfield (1802-1857) worked out theories on which modern study of hurricanes is based. Self-educated, he collected every possible report of hurricanes, devising a law of storms, publishing many articles in the "American Journal of Science." He demonstrated that "a tropical storm is an organized rotary wind system and not just a mass of air moving straightaway at high velocities."

The book describes the students of hurricanes up to the development of flights into hurricanes by planes. The descriptions of the turbulence endured by the men in these planes make it incredible that there have been so few fatalities. The fact is stressed that the courageous fliers are stirred by constant thought of how life and property can be saved by their work. Toward the end of the book, on page 252, one short paragraph proves their accomplishment:

"Very great progress has been made in recent years in sending out timely warnings . . . At the beginning of this century, a hurricane causing ten million dollars in property damage was likely to take several hundred lives. Twenty-five years later, the average was about 160 lives. Ten years later (1936-1940 average) the figure had been reduced to twenty-five and was steadily going down . . . Experience in prediction, on-the-spot operation, and fast communication are vital."

The book is written without literary pretensions of any sort. It is of value for its simple exposition of an increasingly important subject.

GRACE E. BARSTOW MURPHY

THE SECRET OF THE HITTITES

----- by C. W. Ceram

Alfred A. Knopf, \$5.00
281 pp., 48 plates, line drawings

THE great popularity enjoyed by *Gods, Graves, and Scholars* several years ago will undoubtedly be followed by a similar reception for this second book by C. W. Ceram. His subject here is a more specialized one, but the manner of writing is the same, and we find ourselves acquiring a considerable knowledge of Hittite archeology and history in a book that has the compelling interest of a good novel.

The book is actually constructed like a novel. The story opens with an account of the first discoveries in the early nineteenth century of great ruins in Asia Minor that were soon ascribed to the Hittites. The plot that develops is the gradual evolution of our knowledge of the Hittites through various archeological episodes and is climaxed with the final "cracking" of the Hittite hieroglyphics, which is just now being completed. The Hittite Empire, which was all but completely unknown a century ago, becomes vindicated as having played a major role in the political and cultural history of the Near East in the second millennium B.C. As protagonists the story has the archeologists and epigraphers whose personalities are explored and whose discoveries or disappointments give the reader a feeling of participation in the quest.

When a nonspecialist writes a book on a scientific subject, there is always the chance that an expert who has devoted his life to research in that field will find fault. In general, however, Ceram seems to have been careful, and if specific details may be debatable, the author must be commended for giving the layman a most readable and informative book on a subject of great interest.

GORDON F. EKHOLM

THE NEZ PERCÉS: TRIBESMEN OF THE COLUMBIA PLATEAU

----- by Francis Haines

University of Oklahoma Press, \$5.00
329 pp., 21 illus., 3 maps

THE history of the Nez Percés tribesmen of the Columbia River plateau represents something of an American Indian success story: Indians who were, on the whole, friendly to whites rather than hostile, who were adaptable and receptive rather than backward and resistant, and who have become respectable citizens rather than drunken bums.

It is difficult to know how and why the Nez Percés succeeded where other tribes failed. As a matter of fact, this little band of plateau dwellers began its career of adaptation with two strikes against it. The tribe inhabited what was in pre-Columbian times one of the most culturally retarded areas of North America. A sedentary people who lived by fishing, hunting, and gathering wild camas bulbs, they became famous horsemen and horse breeders in spite of the fact that horses were not an economic necessity and were actually a luxury.

The Nez Percés are the only Indian tribe on record who practiced selective breeding of livestock without being taught it by a civilized neighbor, and they bred the gaudiest horses that na-

ture has produced — the famous two-toned sport models with polka dots known as Appaloosas.

The history of the Nez Percés is colorful and unusual. The tribesmen welcomed Lewis and Clark and actually aided their expedition. The Indians became Christians of their own volition and actually invited a delegation of missionaries to their villages. Until the Idaho gold rush of the 1860's, they lived peacefully with the white man. When this invasion precipitated the Nez Percés War of 1877, Chief Joseph, often called "The Red Napoleon," led one of the most brilliant strategic retreats in military history. In recent times they have learned to compete with the white man on his own level and in his own terms. This book is a valuable contribution to the culture history of a little-known tribe.

HARRY TSCHOPIK, JR.

ALMANAC AND WEATHER FORECASTER

----- by Eric Sloane

Little, Brown & Co., \$3.50
163 pp., 104 illus.

A REVIEW of Eric Sloane's *Almanac and Weather Forecaster* must of necessity reflect a major schism which the book presents.

The reader is taken into tow by Mr. Sloane, wandering and working with him through the length of one year, sharing the author's reflections, experiences, and observations at "Weather Hill," Brookfield, Connecticut.

The sensitivity and insight of Sloane the artist is woven with the fund of knowledge garnered from the practical experiences of Sloane the true rural-suburban dweller to create for the reader a sweeping range of the sights, sounds, and smells of a typical New England community as it bares itself to the changes of the seasons.

Rustic, folksy, and woody images are charmingly drawn by Mr. Sloane. The nostalgic flavor of the old ice-cutters, of wood weathered by the winds of many years, of the delightful sayings and proverbs of generations of New England farmers are warmly etched in words and drawings by the author. The reader will enjoy Mr. Sloane's theory of how ducks make forced landings on frozen roads and how the American Indians' representation for a thunderstorm so closely resembles that of the weather map symbol.

But we are told that this is a weather book — that "anyone can become his own weather expert simply by looking out the window." It is precisely this

continued on page 161



▲ THE WOMEN make floor mats, table mats, and baskets from tough grass by an intricate knotting technique. The designs are attractive, and the craft is profitable.

STONE AGE ARTISTS of Milingimbi



A friendly visit among the Aborigines of Arnhem Land, who are retaining the best in their culture under a plan of government help

By LYN HARRINGTON

Photographs by RICHARD HARRINGTON
from *Three Lions*

THE Aborigines of Australia have long been known as a vanishing race. But just as some of the North American Indians and Eskimos are now on the increase, so the tide has recently turned for these people. There are about 50,000 Aborigines of pure extraction, and their numbers are growing.

Education, social work, and health services greatly increased once the government realized that the natives were there to stay. Non-permanent reserves have been established to provide protection but not segregation, and to enable them to be fitted for Australian life as full citizens. Schools, hospitals, government agencies, and missions are

allowed within the reserves, but no other encroachments. In fact, you need permission to enter Arnhem Land in the north of Australia. This is the largest of the Aboriginal Reserves, and it embraces 31,000 square miles of rocks, sand, jungle, and seacoast.

Permission granted, we made the only possible visiting arrangements—to stay as paying guests at one of Arnhem Land's ten missions. We were happy to be assigned to the Methodist Mission at Milingimbi, 275 miles east of Darwin, on one of the Crocodile Islands.

We set off early one morning, before the wind should whip up to buffet the light airplane. Rain dripped from the wings in one of the numerous downpours, which left Darwin sparkling bright but stewing in humidity. It was the beginning of "the Wet," a four-month season of intermittent rains and high temperatures.

The land below us looked empty,

◀ IF A WIFE devotes herself to marketable handicrafts at the expense of her food-gathering duties, tradition permits the husband the privilege of walloping her on the head or body with the wife-heating blade. It is quite capable of splitting a skull, but husbands usually stop short of that.





▲ THE WIFE carries this attractive basket when she goes foraging. The strange little quarter-skirt is made for sitting down.

➤ A SINGLE LEAF will set Geirwana digging for a yam. She knows at a glance which are edible and which are poisonous. Her digging stick is her one implement—for clams, crabs, lizards, and roots.

except for occasional cattle stations and the futile little roads that once led to American Army camps. Then we were over Arnhem Land itself, where brown rivers snaked sluggishly toward the Arafura Sea. They were already in flood, and some would be 20 miles wide later in the season.

On marshy plains, we saw wild buffalo, introduced from Malaya, standing in family groups. A few tossed their horns threateningly at the aircraft. For some years, the buffaloes were shot for their tough hides. But their inaccessibility and the sagging price for the heavy leather protects them now.

Clouds of ducks sprang into the air from the swamps. Then, for mile after uninteresting mile, the country slid beneath us. Red eroded cliffs appeared inland, but mostly there was just monotonous thin jungle, with never a sign of life.

"During the 'Dry,' you can sometimes see small wurleys along the riverbanks," the pilot told us.

The huts he referred to were not in evidence. Actually, these northern tribes scarcely need houses except for the small bark shelters they set up during the wet season. At other times, they lead a roving existence, hunting within well-defined though invisible boundaries. They still do not trespass on another clan's hunting grounds, although the intruder is no longer greeted with spears. Life is easy for these tribes of the tropical north,



compared with the effort of wringing out an existence in the intensely dry interior.

We came down at a tremendous airfield. "The Royal Australian Air Force used this mission as a base during the war," our pilot commented. "It was bombed a few times. You can see bullet holes in the coconut palms."

Aboriginal Farmers

The Aborigines had been well treated by the occupying Air Force and had enjoyed the buzz of wartime activity. Life today, as a result, seems monotonous. A plane doesn't surprise them in the least; and they welcome any break in the routine.

Rev. A. E. Wells, the English missionary, met us in his jeep, and we drove two miles between needle-pointed red anthills and pre-

historic macrozamia cycads, intermediate between tree ferns and palms. The buildings of the mission were set on concrete bases to foil the termites, or on high posts to avoid the worst of the mosquitoes.

Some 60 acres of land were cleared, half in plantations of mangoes, pineapples of incredible sweetness, custard apples, citrus fruits, peanuts, potatoes, and other garden produce. The mission had also built up a herd of goats and cattle to provide food for the staff and for the Aborigines settled in the vicinity. Magnificent tamarind trees grew beside a pool and along the beach—living memorials to Indonesian traders who came from Macassar 50 years ago.

Men and women worked in the fields, not very hard, for the script-and-rations wages paid by the mission. Some women wore cotton

dressess, but most preferred only a skirt. The men wore khaki shorts or a cotton square tied at the corners, called a *nagha*.

Away from the mission, they usually dispensed with everything except personal adornments. The *nagha* had its uses, though. It was a good substitute for pockets, and an astonishing amount could be tucked inside without bulging. Youngsters dressed like their elders, although small children wore nothing at all.

I had no sooner climbed out of the jeep than a bright-eyed boy parroted, "How are you? I am fine. You know Hop'long Cassidy?"

I nodded, "I know of him." He couldn't say another word for the glory of it, and besides, his English was very limited.

He knew Hopalong Cassidy from the outdated movies shown weekly



STONE AGE ARTISTS OF MILINGIMBI

◀ LEARNING TO THROW A SPEAR accurately with a throwing stick is an essential part of every young man's education in Arnhem Land.

▼ TWO HUNTERS OF ARNHEM LAND standing in characteristic pose by one of the large termite nests, which are sometimes used by the natives as guideposts.





▲ "THIS is the sort of fish we grow here," said the boy, displaying the armored snout of a sawfish taken in the tropical waters off north Australia.

▼ PLAYING THE FIVE-FOOT MUSICAL TUBE, the *didjeridu*. It is ornamented with designs of painted clay and bound with feathers. Baralji is wearing the na



at the mission. Westerns were most popular, Mr. Wells told us, and sometimes the effect carried over into daily life. After one such film, the boys decided to lasso the mission donkey, which was running wild with the island horses. They managed to rope the animal, but it escaped and strangled when the

liariat caught on a root. The tribal elders decided that as punishment the boys must carry bushels of sand to make an effigy of the donkey on the ground. The corroboree that night celebrated the donkey's sad tale in song and pantomime.

The children overwhelmed us at first. Every time we emerged from

the mission, they would throng around us, eying us brightly. Their noisy responses mimicked our words and expressions with satiric exaggeration.

I suddenly understood the alarm the early Australian settlers felt when surrounded by hordes of skinny, vociferous, wild-looking people. Their black skins gave them a sort of anonymity, though they were by no means identical in features. I retreated ignominiously.

What a paradox, that I should have come so far to see these people, and at considerable expense, only to sit indoors reading anthropological treatises while Anthropology itself sauntered a few yards away!

So I lathered up with mosquito lotion and stepped outside. Promptly one brash youngster demanded, "Got lollies [candies]?" They had not really come for handouts but for the excitement of being noticed. They bore us off up the beach under the tamarinds, where families rested in the shade or worked at crafts.

While no Aboriginal will develop



THE REVOLVING STICK kindles a tiny spark, which is quickly placed in a bundle of dried grass. The fire maker then blows gently to create a flame.

Making fire

by the ancient method.

The amateur is more likely to produce only blisters.





▼ TWO AGING ARTISTS, the "Rembrandts of Arnhem Land," painting the cloud-and-oyster design on a small boy for the corroboree.



▲ AT A REMOTE PLACE on the beach, the men were working on a "magic stick." This was to be used in a special corroboree.

ulcers from tension or overwork, the Yulnu (the People) do keep occupied as a rule. The women gather grasses and roots to make string, which they weave into bags and baskets and mats. The mats are particularly attractive, and many are sold through the mission—small ones for table use, large ones for the floor. Everyday implements are adorned with clay painting or with incised geometric designs.

The Family at Work

The men of the tribe spend their time hunting with spears, fishing in dugout canoes, or making weapons and sacred objects. They bring home large fish, wallabies, birds, and turtles. The women prepare the food, and it is their duty to collect "ground tucker," which is any food that grows or can be unearthed. This includes fruits, berries, yams, bulbs, lizards, crabs, or large insects.

Hunting with their parents has given the children very sharp eyes, and a single leaf will reveal the location of a yam. They pointed out bright red fruit on an unfamiliar

tree and assured me that it was "good tucker." Small berries came under the same category.

The mosquitoes were dreadful in the sticky heat. Every now and then, the children would stroke my arms, which I assumed was a sign of affection. It wasn't. They were surreptitiously transferring the mosquito lotion to their own skins! But one delightful girl elected to walk behind me waving a branch to keep the flies away, reminding me of old steel engravings of the Queen of Sheba.

When the mosquitoes become unbearable (and the Yulnu can endure a lot of such punishment), the men strip a stringybark (eucalypt) tree and lay great bark sheets over a framework. A platform of poles serves as a sleeping bench, underneath which they build smoky fires. The choking smudge is just slightly preferable to the insects.

Two clans of natives lived at

either end of the beach. Those at the north seemed more energetic and ambitious. Most had built themselves small huts of corrugated iron (a favorite building material in Outback Australia). Those at the opposite end were content with small wurleys of bark or iron bent over like a half tube, scarcely high enough to sit in. Boys who had begun their initiation lived by themselves in a spot taboo to females.

Uninitiated boys and women are forbidden to look upon sacred objects, though to do so no longer seems to carry the death penalty. One day as we went up the beach, the women suddenly screeched something, and my guides sheared off inland. In a secluded part of the beach, the young men were engaged in some ritualistic procedure. The boys steered my husband in that direction, not daring to look themselves. Although he was no initiate, my husband was permitted

to watch, and even to photograph. The men were rolling pieces of hair into twine with bits of down to make a "magic stick."

Art is a significant part of everyday life among the Australian Aborigines, and it reaches its height among the tribes of Arnhem Land. They engrave intricate designs on long tobacco pipes, paint the women's baskets, and even decorate the wife-beating blade. Custom permits them to use this latter implement if the wife neglects her food-gathering duties.

Mr. F. D. McCarthy, Curator of Anthropology in Sydney's museum, has pointed out that we have been slow to appreciate this aboriginal art. We now realize that these people possess an art that is full of traditional meaning and rich in interesting motifs, placing it higher on the artistic scale than we have previously thought.

One group of craftsmen, gathered under a tree, were carving angular figures out of soft wood—fish, turtles, crocodiles, humans. These were decorated with clay paints in their own symmetrical designs.

"The Aborigines must have education to meet the white Australians on their ground," Mr. Wells explained. "That means settling down. They need some way of making a livelihood once they give up living off the land. We tried out this idea, and the Yulnu took to it at once. We buy these things and ship them to Darwin, where they're sold to tourists who want souvenirs of Aboriginal workmanship."

A couple of men were sitting on the gunwale of a boat drawn up on shore, alternately puffing on a three-foot tobacco pipe, which they shared with anyone who came along. Its stem was decorated from bowl to mouthpiece with geometric designs crosshatched in ochre. Between puffs, one man idly drew in the sand the outline of a fish, then filled in with crosshatching. Certain of these northern tribes make "X-ray" drawings that include the internal organs.

Paintings on rectangles of stringybark, however, represent the high-

est development of Australian primitive art. Those who paint them are Arnhem Land's "Great Masters." Their work shows great skill, and the artists use a wide range of motifs, grouped into decorative panels. The art seems abstract to unaccustomed eyes, but it is immediately intelligible to those who know the conventionalized symbols for cloud, rain, turtle, heaven, and territorial boundaries.

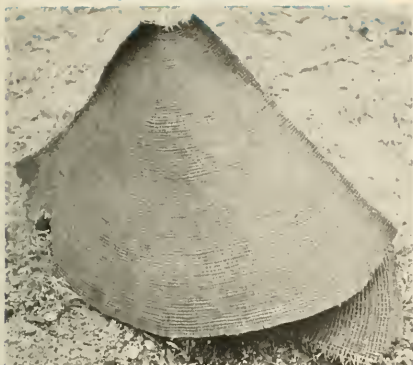
Another day, we watched Dainginum, considered the greatest Stone Age artist alive today, working with vast patience on Mowinkel's little black body. Yilgari, another aging artist, assisted at intervals. For five hours, the little eight-year-old boy lay on his back without a murmur while the paint was applied.

The two old masters took their time with preparations. White pipe clay was reduced to a powder between two stones, then transferred to a clam shell with a bit of water. Red ochre was ground up and placed in a second shell. More red ochre and white pipe clay were mixed to form a yellow. (Black pigment comes from charcoal or mud, but they did not need it in this instance, since the child's own skin provided an effective black accent.)

Dainginum drew the outlines for the cloud-and-oyster design; then, with a twig that he flattened between his teeth for a brush, he filled in some of the scallops. For fine lines, which call for a skillful and steady hand, he used the rib of a small feather. Although his colors, implements, and motifs were



▲ THE MAN who is considered the greatest of Stone Age artists living today: Dainginum, displaying a selection of his work on a framework of spears. Each panel tells its own supernatural story.



▲ THIS INNOCENT CONE of matting did not move for hours...

► ...Then the photographer saw a hand and a foot emerge.



limited, he achieved a notable result, and every stroke had specific meaning to his fellows.

The intricate cloud-and-oyster design was the totem of Mowingel's family, and only the annual "natural increase ceremony" would call for an elaborate painting like this. It is a ritual believed to increase plant and animal life. In general, only initiated males are painted for tribal ceremonies.

Entertainment After Dark

Nearly every night, some singing and dancing went on around the encampment, like our old-fashioned parlor entertainments. At times, the entertainment took a more elaborate turn, the equivalent of a school concert, say. The corroboree was a serious occasion with historic and religious overtones, like Memorial Day, perhaps; and it drew hundreds of natives from a large region.

The host tribe provided most of the food, though visitors brought some. We often heard the Yulnu at Milingimbi preparing for a very special corroboree to celebrate the Morning Star. This took weeks of preparation and went on for three weeks once the tribes had assembled.

Mr. C. P. Mountford of the Adel-

aide Museum recounts the legend. "At Purulka, the aboriginal heaven, all night is spent in singing and ceremony. As dawn approaches, two women say to the chief spirit, 'Is it not time you let the morning stars out of the bag, so they can go to earth and wake the people? If you do not, they will sleep all the time, and perhaps die.' So the spirit opens a string bag, and the stars escape, each to his own country. When the Aborigines on earth see the morning stars rise, they get up and go about the day's work. Then, as the sun starts to rise, the spirit man at Purulka takes hold of the strings to which the morning stars are tied, pulls them in, and stows them away until next morning."

Corroborees take place at night, in a specially selected spot, where initiated members in paint and feathers perform ritualistic dances. The women sit on the sidelines, sometimes completely out of sight, beating time or chanting in sing-song style. The dances represent tribal activities, history, and hunting adventures. Today, the people sometimes re-enact a movie or portray some misadventure of a white man. The Aborigines are marvelous mimics.

After a serious corroboree, the natives scatter to their hunting

▼ LO AND BEHOLD, the old boy was only trying to take a siesta without bothersome mosquitoes.



grounds, spiritually refreshed by communion with their "Dreaming." "The Dreaming" refers to tribal history and tradition and territory, always linked with the supernatural.

Night after night, from an open glade at Milingimbi, came the clacking of hardwood *gilgil* sticks and the drone of the *didjeridu*, a

continued on page 145

The ALASKAN Snow Flea

Its adjustment to life on and in a glacier is so extraordinary that science can as yet only guess how it reproduces the next generation

By CARLETON RAY



▲ IT IS ON THE UPPER REACHES of glaciers like this one in the Juneau Ice Field that these tiny creatures sometimes become so numerous as to make the snow look dirty.

◀ THE UPPER, LARGER ANIMAL is a rock-snow horderline type of snow flea that does not venture far out onto the snow. The lower, smaller one is the species discussed in this article.

YOU might conclude that I was hard up for company when I got interested in snow fleas on the 700 square miles of the Juneau Ice Field. But the fact is that I would have found them fascinating wherever I might have run across them. And I had good company in the team of scientists with whom I took up residence in a sixteen-foot-square Jamesway hut on the edge of the Lemon Creek Glacier.

We hadn't been there long before we realized that this glacier

looked like just about the dirtiest hunk of snow and ice we had ever seen. We were on the verge of a discovery but didn't know it.

Except during periods when fresh snow was on the surface, the upper glacier, which because of altitude is never bare of snow, had the appearance of being liberally sprinkled with soot or pepper. Shortly the light dawned on us: the dirt moved. It didn't move much but enough to establish that it was *living* dirt.

It was up to me as zoologist to get down on my belly and try to determine what sort of beast we had discovered. And so I did, but every time I tried to pick up one of the little specks, it would give a sudden jump of about an inch and disappear down into the snow.

It was clear that we were dealing with snow fleas, which belong to a primitive order of insects called springtails or Collembola. The name "springtail" is derived from the fact that this insect has on the rear end of its abdomen a projec-

★ The author made these observations while working under a special grant from the Arctic Institute of North America with the American Geographical Society's Juneau Ice Field Research Project, both of which are supported by the Office of Naval Research. ★



tion that folds forward under the body and hooks into a little extended bump on the mid-body. When this "spring" is suddenly released from its forward position, it flies backward and has the effect of throwing the insect forward. Because of this jumping power, the inoffensive springtails are called "fleas," though their relation to the familiar biting kind is remote—thank goodness!

I managed to collect some specimens and sent an assortment to Dr. Harlow B. Mills, a leading expert in this field of science. My excitement grew when he wrote: "This collection is the most interesting one I have ever seen from Alaska." He then commented on my suspicion that these snow fleas might be the only North American ones yet found that were accustomed to living on the snow more or less permanently instead of merely occurring there by accident.

The question of how this tiny animal has adapted itself to such a harsh environment and what it uses for food carried us into some Lilliputian explorations. Man, being something of a giant among animals in the broad sense, tends to

notice only the creatures that approximate him in size. I began to realize how unfortunate this is as I delved deeper into the secrets of the snow fleas.

Springtails are found the world over in a great variety of habitats, from glaciers to tide pools. But most kinds live in the litter of forest floors. They all seem to be herbivorous, eating what plant material is available. Some are extraordinary jumpers, able to leap a full six to eight inches, or 100-150 times their own length. Snow fleas are not of such Olympic calibre. Still, the inch they do jump is equal to 25 times their length, which is equivalent to a man jumping 150 feet from a standing start.

The reason I doubted that my snow fleas merely ventured out onto the snow in good weather, as all respectable North American snow fleas were supposed to do, was that they were most numerous in mid-glacier, a good half mile from the nearest rock. At least, this was the case during summer. I was satisfied that this species spent its time in summer exclusively on the snow, a habit that had been ob-

served among some of their European cousins in the Alps.

In these mid-glacier regions, snow fleas were amazingly plentiful. Under ideal conditions, as many as 120 could be counted per square foot of snow. Ideal conditions seemed to exist when the day was fairly warm (45 degrees or above), either sunny or cloudy, and with the air fairly still. They seemed to disappear when there was wind, precipitation of any sort, crusting of the surface, or darkness. Where did they go? They disappeared down into the snow, believe it or not.

Snow fleas are small; otherwise they could not use the tiny spaces between the crystals of coarse snow. These crevices are absolutely essential to the snow fleas for purposes of retreat.

How could such tiny cold-blooded creatures stay warm in this world of snow and ice? We need not wonder so much about them during the day, when they are able to absorb heat from the sun's radiation even when the sky is overcast. All snow fleas, with the exception of the golden snow flea, are black—a characteristic not often found among springtails that do not frequent the snow. This color helps them to absorb infrared or heat radiation. Infrared can penetrate clouds, which explains why these animals are not much affected by cloudy skies. The temperature of the snow where they live stays close to 32 degrees all through the summer melt season, and the snow fleas themselves no doubt become much warmer than this.

But with the coming of night, the snow flea's existence becomes much more complicated. As soon as the sun goes down, the air cools and the surface of the snow radiates back into the atmosphere some of the heat it has absorbed during the day. This may result in crusting, but whether a crust forms or not, the snow fleas retreat soon after sunset to the tunnels and caverns under the surface. There, their temperature probably falls to that of their surroundings—32 degrees F.

continued on page 16b



Galloway

Sired by a jackass —

with a horse for a mother —

unable to propagate himself —

this rugged individualist has helped promote

an economic evolution that has left him jobless



Frederick Lewis

Unsung Empire Builder— The MULE

By GARY WEBSTER

POEMS and statues, paintings and ballads pay tribute to the horse. His half brother, the mule, is a noble beast without whom history would be quite different. Yet few pause to recognize his central role in the drama of western civilization. Instead of singing praises of the sturdy hybrid, those who know him best devote their talents to framing new jokes about him.

Most jibes directed at the beast focus on one of three matters. First, he is sterile—quite incapable of propagating his kind. Second, he is the offspring of a jackass (mated to a horse). Third, in season and out, he kicks with great skill and every evidence of malice aforethought.

"No wonder the mule is so ornery," runs a proverbial quip. "He's the only common animal who has neither pride of ancestry nor hope of posterity." Josh Billings, homespun humorist of the last century, put it like this: "The mule is haf hoss and haf jackass, and then kums to a full stop, natur discovering her mistake."

Youngsters of past generations learned to joke about the jar-head

as though he had no redeeming qualities. "The best way to put a mule into his stall," said a standard formula, "is to hire someone else to do it." Half a hundred collections of humor included the question, "Why does Missouri stand at the head in mule-raising in the U. S.?" "Because," ran the answer, "it would be dangerous to stand at the other end." Grandpa thought that one hilarious.

Perhaps the ancient herdsman who saw the world's first mule blinked his eyes and concluded that nature had played a joke. For even the most ardent admirer of the animal never entered him in a beauty contest. He looks just like what he is: a cross between a donkey and a horse, with all the most unattractive features of both.

Yet the ungainly fellow soon proved his special usefulness. Near Eastern breeders of prehistoric times knew the mule to be stronger than the donkey, tougher than the horse. What he loses in looks, he gains in fortitude. From his mother, the mare, he derives strength and courage. From his father, the jack,

he inherits patience, sobriety, and sure-footedness.

His skin is harder and less sensitive than that of the horse. He is less impatient under heavy loads, more cautious in places of danger, less susceptible to disease. Like his father, the mule thrives on a diet so coarse that it would make a horse ill. He has the donkey's indifference to heat, the horse's capacity to pack heavy loads. As a work animal in hot regions, he is magnificent.

Assyrians and Egyptians appreciated him so highly that they sometimes represented him on monuments. They used the mule as a pack animal, reserving their horses for military expeditions. Neither beast seems to have been abundant, for human labor was the chief source of energy in building the pyramids and other great structures of the period.

Mules were still comparatively rare when David became King of Israel, some 3000 years ago. His sons, the princes, were proud to have them for their personal mounts. Solomon even rode a mule when he was proclaimed king, and



▲ THE MULE is the most successful hybrid that man ever developed.

the high value that was placed on them is indicated by the fact that they were among the yearly presents given him during his long reign.

The people of Israel were prohibited from breeding their own mules (Leviticus 19:19). So they probably imported them from great stockyards in Armenia. Old Testament references indicate that the mule was used as a beast of burden and baggage animal in war, and he was harnessed to litters as well as

ridden. Sennacherib carried off a large number of mules after he invaded and conquered Judah. Conversely, exiles who returned to that land from captivity in Babylon brought home 245 of the animals.

During this era, the hybrids were used to pull chariots in the great city of Nineveh. One monument even shows a woman of the city riding a mule. Another ancient marker depicts gay blades of Babylon riding mules to a deer hunt.

The Romans who became mas-

ters of the known world had a high opinion of the mule. Already, breeding had become a recognized art. It was well known that mating of a stallion and a female donkey never produced a mule. Such a hybrid, vastly inferior to progeny of a male donkey and a mare, was called the *hinnus*. Centuries have modified the name but little. Still familiar to stockmen as the hinny, this animal is never intentionally reared.

Detailed knowledge of genetics is still lacking, but it appears that



Brown Bros.

▲ STAGGERING UNDER heavy packs, the mules followed the miners to and from gold deposits in the Klondyke.

In the Gold Rush

horse- and donkey-qualities are transmitted quite differently. Hybrids seem to get the size and body of the mother, whereas the feet, head, and tail appear to be most affected by the father. So a horse father and donkey mother produce a creature that most people consider all but useless, the little hinny, while a donkey father and a horse mother produce the sturdy, sure-footed mule.

Though stockmen in the time of the Caesars had no scientific explanations in terms of chromosome reactions, they were well aware of differences between *mulus* and *hinus*. They bred the former so effectively that the Latin name was only slightly changed in transmission to English and other languages.

They had not yet formed the modern attitude of scornful contempt toward the mule. The Romans used the animal for carrying packsaddles, drawing carriages, and plowing in light soil. They even employed an enclosed chair attached to two long poles, especially designed to be slung between two mules. Passengers were wealthy and high-born ladies who could afford to ride in style.

The decline and fall of the Roman Empire caused the center of progress to shift southward. For a period of several centuries, Africa

threatened to regain her ancient position as hub of the civilized world. Mule-breeding continued throughout this epoch. Fine hybrids were greatly prized, for governors of both Syria and Egypt sent them as gifts to the prophet Mohammed. One white mule named Duldul was accompanied by a bale of rich clothing and two Coptic slave girls. Mohammed was not especially interested in the girls but took great pride in his white mule.

Followers of the prophet invaded Europe early in the eighth century. Charles Martel and his Franks stopped their advance in 732, but the swarthy fanatics clung tenaciously to most of the region that later became Spain. They were hardly established in their new domains before they began breeding mules, for the hybrid seemed especially fitted for service in the rough, mountainous country. Generations of experiment had already given Moorish stockmen great skill. Now they produced mules with big, strong bodies—plus the slender legs and small feet of a donkey.

It was this type of mule that became the major pack- and riding-animal of old Catalonia. Firmly established in most of Spain, it remained behind when Europeans began to drive out the Moors, in the thirteenth century.



Black Star

In Commerce

▲ LAST of the 20-mule team Borax wagons. Mules survived heat and poor food as no horse could.

By this time, however, the sure-footed animal was strongly linked with the hated invaders who had made such good use of it. Some even argue, in fact, that the derogatory views of the mule may stem, at least in part, from centuries of strife between horse-breeding Christians and mule-breeding Moslems.

Outlawing the Mule

As soon as King Alfonso X became master of Castile and Leon, he tried to outlaw Spanish use of the mule. His first edict was issued soon after the capture of Seville, in 1248. According to it, the *caballero* of Spain was required to forego use of the mule and stick to the ancient and honorable practice of riding the horse. But many a mule must have given Alfonso the Learned, as he was called, a lusty hee-haw. For even the nobility rode hybrids in preference to the clumsy, high-spirited horses then being bred.

Matters reached such a state that a special report was made to Ferdinand and Isabella, just two years after the discovery of America. According to it, the nation could muster only 10,000 or 12,000 horses for use in battle against the Moors. Meanwhile, at least 100,000 subjects of the king were riding mules. Ferdinand pulled out dusty codes,



In Agriculture

EASY TO KEEP and easy to feed, the mule is treasured by the farmer.

ordered that only clergy and women should ride mules—on penalty of having the mounts killed.

Christopher Columbus was decidedly put out. In 1505, he asked for a special license that would permit him to ride muleback instead of horseback. His Majesty graciously granted it to the old explorer by virtue of his age and infirmities. But he made it clear that this Moorish practice was not for everyone. A few mules were actually executed at Valladolid and other towns because their owners insisted on riding them.

Adventurers and explorers in Spanish America found conditions that demanded the use of mules. Importation and breeding soon reached major proportions. For 400 years the drab and despised mule served as the most important work animal of the two continents.

It was the mule who proved hardy enough to survive the rigors of swamps, deserts, and mountains. The world's most significant pack trail at that time crossed the Isthmus of Panama from Panama City on the Pacific side to Nombre de Dios on the Atlantic. Leather, grain, meat, and other provisions were shipped west; gold and silver came east. And Nicaragua became the great center of mule-raising for the isthmus trade. It was not unusual



Black Star

In Recreation

➤ ON A GRAND CANYON TRAIL, where sure-footing counts, the mule is dependable.

for 1500 animals to leave one of the terminal cities in a single day. Most of the loot of South America that was funneled into Panama crossed the isthmus by mule train, then went to Europe by ship. In the single month of March, 1550, the Spanish hauled 1200 muleloads of gold and silver to Atlantic ports.

Inevitably, privateers began to eye the situation with great interest. Sir Francis Drake heard that the mules of the isthmus packed metal bars as though they were cordwood. So he attacked a train on Valentine Day, 1573. To his disgust, the Spanish had sensed trouble and sent only less important freight. Six weeks later, however, the dashing Englishman captured a valuable train of 190 mules. But he had only 35 Eu-

In War

EVEN in mechanized war, mules played a strategic part. *Left*, training a stubborn pupil. Eventually he will get used to flying to work.

Gendreau



ropeans in his command, and—carry what they could—they had to leave more than 15 tons of bar silver behind.

Mule traffic along the strategic trail continued long after the flow of precious metal was exhausted. Goods shipped to or from California could take one of two routes: the long, precarious voyage around the Cape—or across Panama by mule. Consequently, business boomed during the California gold rush. Mules staggered westward with miners and their gear, packed millions in gold back to the eastern coast.

As late as 1852, Captain Ulysses S. Grant and company rode mules on one leg of the trip across Panama. Though a railroad line was then under construction, mule trains operated between the end of the line and the coast.

Mules were a major factor in the early development of California. Pushing slowly northward from Spanish centers, the hybrids were numerous in fifteenth-century Mexico. As fast as missions were established in new territory, mules went along. Charles III of Spain decided in 1768 to settle the northwestern portion of his North American Empire. So he sent a viceroy with orders to build posts in such spots as San Diego and Monterey. Starting from Lower California, the expedition gathered stock from every mission on the way. They found 16 broken mules at the Mission of San Francisco Xavier, 26 at San José de Cummundia. When they had accumulated more than 100 of the essential animals, along with a smaller number of horses, they moved into Upper California.

Cowboy movies to the contrary, the mule played a more significant role in the development of our West than did the more glamorous horse. Mules survived heat and poor food that no horse could endure. They reached a peak of usefulness on the Sante Fe trail, where Mexican "mule skinnners" packed animals with loads up to 300 pounds.

Mules pulled clumsy mud-wagons—light coaches similar to the army

ambulance—over multitudes of trails and rough roads. Three pairs of them were hitched to the first Concord coaches that rolled west of the Mississippi. Even in 1875, more of America's freight was hauled by mule trains than by railroads.

Travel difficulties were such that it was not feasible to bring mules from the southwest to farming regions of the east. As late as 1826, the vast sugar industry of Louisiana boasted only an occasional mule. Two or three expeditions were organized to bring herds of them from the west; one speculator bought 600 in San Francisco for the purpose. Nothing came of his or other efforts.

Home-bred Mules

It was a gentleman planter of Virginia who first saw that farmers of the Atlantic seaboard would have to raise their own mules. His name was George Washington.

As early as September, 1785, he expressed great eagerness to experiment with the hybrids. He gave his agent an order to buy "a good Jack Ass from Spain, to breed from" but found the price too high and canceled the request. King Charles IV learned of his interest and shipped two animals to him as a gift. One died at sea. The other, duly received, was named Royal Gift and given a special stall on the Mt. Vernon estate. On December 19, 1785, Washington wrote a formal letter of "thanks for the Jack Asses." It is still preserved in the Spanish National Archives at Madrid.

General Lafayette sent his American comrade an animal from Malta. Washington expanded his stable so rapidly that when he made his will in 1799, he disposed of 42 working mules and 15 younger ones.

Henry Clay brought a pure-blooded jack into Kentucky in 1832. Four years later, a Dr. Davis of South Carolina imported one directly from Spain. Throughout the southeast, plantation owners clamored for mules. These hardy animals, easy to keep and to feed, offered riches to those lucky enough to secure them. At the mid-point of

the nineteenth century, U. S. mule production was rising faster than that of any other farm animal. The total number in the nation actually doubled between 1850 and 1860.

Tens of thousands hauled ammunition, supplies, and guns in the Civil War. Observers from other nations were tremendously impressed with the stamina of the animal. Both Japan and Russia began buying mules for military purposes; England organized special Mule Batteries for service in border districts of India.

Peacetime uses of the animal multiplied. Spain and France produced great numbers for export—50,000 a year left the Poitou district of France alone. Brazil launched a mule-drawn express coach, with a scheduled run of 100 miles in 12 hours. An expeditionary force into Egypt rejected pleas of horsebreeders, selected mules from Sicily, Missouri, Texas, Tennessee, and Kentucky jostled for leadership in the U. S. trade.

During the second half of the last century, mules literally built empires. They hauled supplies and equipment for work camps along sprawling railroad lines. Vast numbers were worked in mines; some of them spent most of their lives underground. Others pulled barges through canals, streetcars in growing cities, lumber wagons in the forests. By 1875, the mule's prestige had become so great that some of the animals were exhibited at the famous Crystal Palace Show.

General Kitchener was given a special exhibition at West Point in 1910. Sixty-four Missouri mules, recently acquired, were loaded with 14,000 pounds of ammunition and supplies in just 14 minutes. The bond between the animals and the future officers grew so strong that the mule became mascot of the West Point football squad.

In spite of mechanized conflict, mules played a strategic part in World War I. Nearly 5000 were killed with the A.E.F. alone. From the end of the struggle until about 1925, the mule continued to increase in importance. That year,

U. S. farms and industries worked nearly 6,000,000 of them.

Ever since that time, trucks and tractors have been replacing mules at an increasing rate. World War II brought a temporary revival to the trade, but interest sagged as soon as production of machines was increased. There is no doubt about it; the hardtail is doomed.

There is something a bit pathetic about the fact that dog-food plants are now springing up most rapidly in sections where mules are most abundant. Give the patient empire-builder another hundred years or so, and he will be all but extinct in the United States. Children of the future will know him only as a queer-looking specimen at the zoo.

Perhaps his stock will rise when he is no longer on hand to provoke abuse, profanity, and crude jokes. No amount of humor at his expense can alter the fact that he is the most successful hybrid that man ever developed. Bred one generation at a time for more than 3000 years, his patient labor was essential to the development of the mechanized culture that has made him obsolete.



Devaney

THIS FAMILIAR FRIEND is vanishing from the American scene. Here, the famous Missouri mules get their last exercise before shipment to Spain, where they are more adaptable to the terrain than machinery.

United Press





▲ AN AERIAL PHOTOGRAPH of some of the largest of the mounds. Some of the



The mounds are about 25 miles southwest of Tacoma, Washington.

After more than a century of controversial theorizing, their anonymous architect proves to have been neither man, fish, nor animal

THE *Mystery* OF THE Mima Mounds

By HOWARD E. JACKSON

All photos courtesy of Arthur M. Ritchie



7 feet high and 70 feet in diameter.

IF you have driven over old U. S. Highway 99 between Portland, Oregon, and Seattle, Washington, you probably noticed the odd-looking mounds shown in these pictures. They look like half gravel-spheres scattered over the prairie on both sides of the highway north and south of the town of Tenino. There are about a million of them.

You may have wondered who or what formed them. Explorers, geologists, naturalists, and casual travelers have been trying to find the answer to that question for more than a century. Now, at last, recent studies of frozen ground in Alaska point the way, and the answer to the mystery is forthcoming.

The one million Mima Mounds, as they are called, are spread over 20 miles. They vary from 1 to 7 feet high and from 10 to 70 feet wide. Those in any one prairie tend to have the same size and shape.

The Indians may have had ideas about them, but the first white man to report them was Captain Charles

Wilkes, who explored the Puget Sound country in 1839 to 1841. He wagered that the mounds were Indian burial grounds. To prove it, he dug into a number of them, but he found nothing except soil and gravel.

Wilkes' face may have been red and his hands blistered, but he wasn't alone in his belief. The burial ground theory thrived down through the years, despite the failure of all efforts to find traces of any animal or human remains.

Sir James Douglas of the Hudson's Bay Company saw the baffling bumps while traveling overland from Fort Vancouver to Fort Nisqually in 1840. He believed they were the result of volcanic eruptions. Then along came George Gibbs. He saw the mounds in the late 1870's and described them to the great naturalist Louis Agassiz, who unhesitatingly explained them as the work of a species of sucker-fish. He said they were built as spawning nests while the area was under water and that the ocean



▲ AIR VIEWS LIKE THIS ONE of the Olkut Lake Section played a prominent part in disproving the hotly debated gopher theory and other imaginative explanations.

➤ ARTHUR M. RITCHIE, proponent of the present theory, standing beside an exposed section of one of the mounds, examining the distribution of material in and under it. Cross sections like this helped to validate the theory that the mounds were deposited by floodwaters and shaped by the interaction of freezing and melting.



later receded and left them exposed.

Other attempted explanations say that the mounds were the work of ants or beavers or some other animal who built them as foundations for homes during a period of flooding.

In 1873, Joseph LeConte, a confrere of Agassiz's, pooh-poohed the fish theory. He was just as positive that the hillocks were the product of natural erosion following the recession of an ice sheet. He thought they formed when waters of an inland sea or huge fresh-water lake drained away.

Pioneers from Kansas and Nebraska swore that the hillocks were similar to ones created by buffaloes

in the Midwest. They argued that the buffaloes produced the mounds while making mud wallows in which to seek refuge from flies. This explanation overlooked the fact that buffaloes were never found in large numbers in western Washington. A few may have wandered over the Cascade Mountains from eastern Washington but certainly not enough of them to create a million mounds.

The most farfetched bison theory was that the Indians built the mounds as buffalo decoys!

Theory followed theory. Some would-be naturalists held that they resulted when high winds swept away the soil except where it clung to the roots of giant trees, but no

wind like that has ever been recorded. Some speculated as to whether underground oil or gas pressure might have caused the swells, but modern drilling has failed to reveal any oil.

Clue in Frost Action

The case started to break with the coming of J. Harlen Bretz, in 1913. In his *Glaciation of the Puget Sound Region*, he concluded that during the Ice Age, silt blowing across the surface of the Great Ice Sheet collected in depressions, and that as the ice melted, this accumulation fell through to the gravel beneath, forming the mounds. His explanation was generally accepted for many years.

In 1932, H. M. Eakin shed light on the general problem by recognizing that frost action could rearrange mixed materials deposited by running water. Now the geologists were hot on the trail. Could it be that the mounds were related to frozen ground? One clue, oddly enough, was to be found not on home ground but in studies of frozen ground in Alaska. Two more sleuths, the U. S. Army and the

U. S. Pernafrast Division, participated in this development.

R. C. Newcomb of the U. S. Geological Survey contended in 1940 that the Mima Mounds were the collapsed remains of buckled blocks of frozen ground, such as can be observed over wide areas in Alaska today. He deduced that during the last Ice Age, the ground in the Tenino-Mima prairie area froze, contracted, and cracked in a pat-

terned network. Ice formed in the cracks and expanded into ice wedges, which caused the blocks of earth between them to bulge upward. When the ice melted, the earth bulges stood out as mounds.

Running neck and neck with Newcomb for the final solution was Arthur M. Ritchie, geologist for the Washington State Highway Commission. Ritchie began likewise with the frozen-ground theory, but he felt that some of the features of the mounds could best be accounted for by erosion of an ice network after partially thawing. He believed that floodwaters during the melting period washed away the thawed material from the unthawed cores of each earth block. The round frozen cores that remained after the flood became the mounds. In other words, he believed that the mounds had been "stripped" by floodwaters and not that they were just the "collapsed" remains of buckled polygonal blocks of frozen ground.

The spacing of the mounds, according to his explanation, was determined by the distances between the original earth polygons. These irregularly shaped blocks of earth thawed appreciably before the flood came upon them, but each block still had within it a core of frozen earth. The shape of this core would be rounded or mound-shaped, inasmuch as the thawing of an irregularly shaped block of earth is similar to the thawing of an ice cube: both become rounded, because the edges melt away more rapidly than the sides. Thawing thus gave to the mounds their basic shape, whereas the floodwater merely cleaned the thawed debris away from the frozen cores.

The timing of each event was an important factor in the analysis of the mounds. If the floodwater had come after the polygons had completely thawed, all of the material of which the mounds were composed would have been washed away. The same result would have occurred if the river had flowed over the mounds a long time.

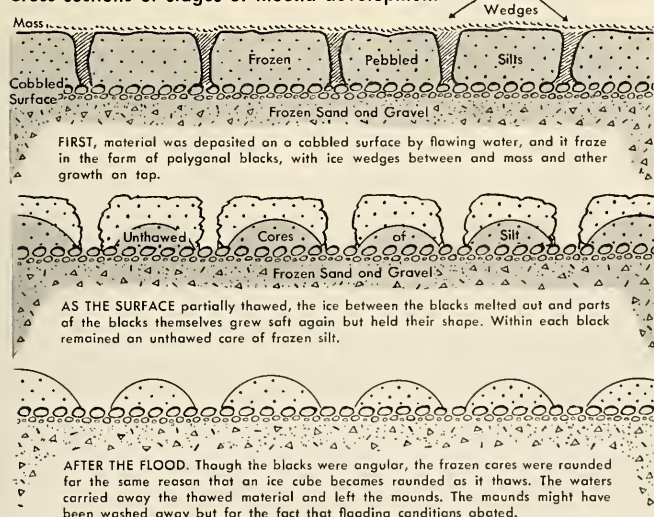
Many times, flood rivers had

continued on page 162



▲ A SCENE in present-day Alaska showing how freezing of the earth can produce the first stage in the creation of features like the Mima Mounds.

Cross sections of stages of mound development





▲ THE 30-FOOT KETCH that carried cameramen Jack Couffer and Conrad Hall to the Galápagos to film scenes for Walt Disney's forthcoming True Life Adventure feature, "Islands of the Sea."

Gal

▼ THE BULL SEA LION that took umbrage when the cameramen wooed his harem into the sea with "sea lion talk."



ONE of man's oldest dreams, preserved in myth and legend the world over, is of a world where humankind and animals live side by side without fear or animosity. But the wild animals that coexist with man in the forests, plains, and shores of the world that we know are shy things — secretive, afraid, forever hiding from man's eyes. There was once a time when the earth was populated by wild animals who lived out their lives without knowing the sight of man — his stones, arrows, or rifle shots — for the animal world is an older world than that of man. But in the relatively short time that man has peopled the globe, his increasing population has spread across the sphere of his habitat to nearly every corner of its surface.

Because of man's ways — hunting ways — a land where animals know no fear must be a land where animals do not know man. There is a spot, a mere dot on a world map, that man, in his haste to populate the world, has nearly overlooked.

This dot represents a group of islands — a few volcanic cones that jut from the deep sea in a seldom traveled part of the Pacific Ocean 800 miles southwest of Panama. They are called the Galápagos Islands. No culture of primitive man has taught fear to the many animal inhabitants of these islands, and even today the population of humans is very small in the Galápagos and very localized. The animals of the Galápagos have yet to learn man's ways.

I went to this remote spot with my partner, Conrad Hall, to film a part of a True Life Adventure feature, "Islands of the Sea," for Walt Disney. In the eight months that we lived aboard the little 30-foot ketch that was both our home and transportation, the strange anomalies of these islands of prehistoric reptiles, volcanic fires, and high crater domes became as commonplace as scenes from our own countryside at home. But even though the geography came to seem ordinary, we could not accustom ourselves to the uncom-

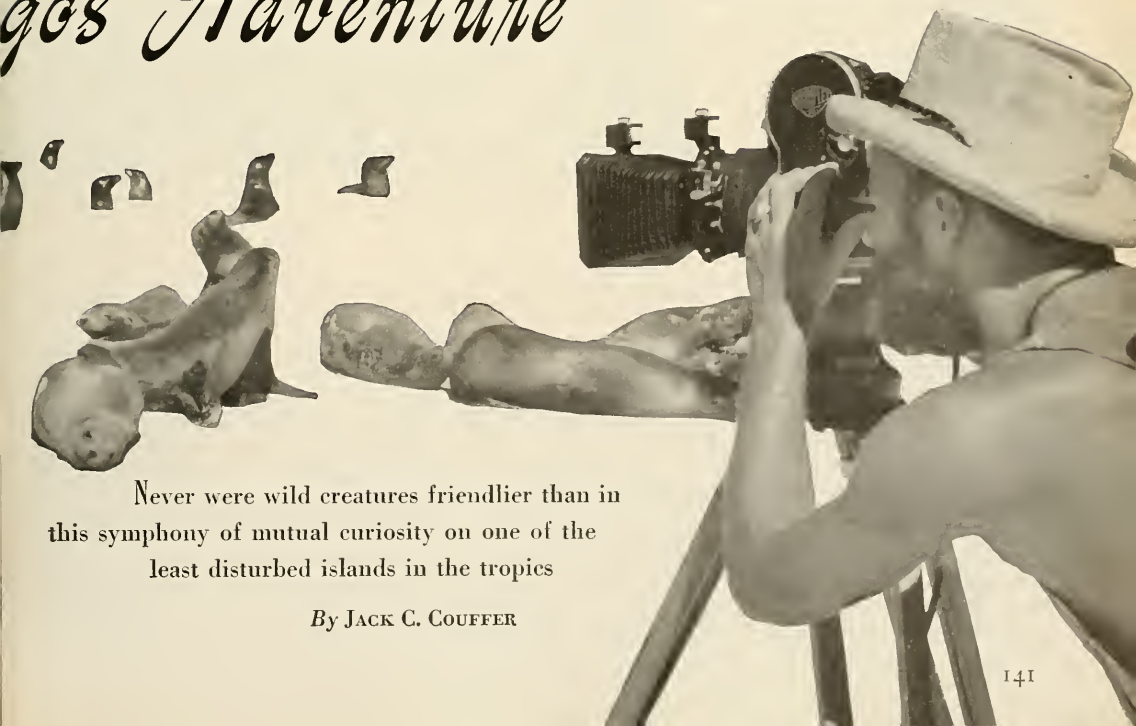
mon feeling of knowing wild animals that were unafraid.

The animals of the Galápagos seemed almost naïve in their curious regard for us. Small gnomelike night herons stood in the firelight around our beachside campfires, their shoulders hunched, forever watching us. We wandered through great flocks of nesting sea birds — albatross, boobies, man-of-war birds, and gulls—and felt that we were tolerated in their rookeries. We sat on surf-washed rocks with penguins and flightless cormorants; and they, like the others, were attracted to us by their uncontrolled curiosity. Even the huge marine lizards that lay covering the rocks of the shore in great herds were unafraid, and as we walked through the closely-packed animals we were careful lest we step on them.

In the Galápagos, mockingbirds perched on our hats, and hawks accompanied us on hikes through the bush. The hawks were large curious birds, and as we walked they would

gos Adventure

▼ CONRAD HALL recording the frolics of a group of sea lions on the shore of one of the islands of the Galápagos.



Never were wild creatures friendlier than in this symphony of mutual curiosity on one of the least disturbed islands in the tropics

By JACK C. COUFFER



▲ A YOUNG BOOBY happily poses for the author.

fly ahead to perch upon limbs that overhung the course of our travel. They stared with bright penetrating eyes as we passed within an arm's reach of their perches, and then, taking off and flying ahead, they again landed on the scrubby limbs of the *palo santo* trees to scrutinize the strange walking things that had invaded their land. For miles they accompanied us in this way, always looking, watching us as if they had the power to gain some understanding of our ways. The curiosity of the animals was almost a travesty of our own behavior: we, who had come to study the beasts, found that we were studied by them as well.

Perhaps our best friends — and, paradoxically, our only enemies — were the sea lions of the Galápagos. We first came upon them inshore from a calm cove. There, on a narrow crescent of white sand beach, bordered on one side by the rough black rock of a lava flow and on the other by dense green clumps of

mangrove trees, a herd of 40 sea lions lay basking in the hot sun. *Lobos del mar*, they are called by the residents of the Galápagos — “wolves of the sea.” But unlike the snarling wolves of the forest, we came to regard the *lobos* of the sea as our friends. The sun-dried fur of their short thick pelage was a golden color, and the herd slept with a deep sleep. They lay one across the other, one animal's head resting upon the neck of another, using it like a soft pillow. They lay so close together that when one *lobo* moved, it disturbed another, so that even in sleep the herd was constantly moving, adjusting to more comfortable positions.

Battle-scarred Master

All but one of the *lobos* were females, animals with small delicately modeled heads. But lying in the center of the herd of smaller animals was the massive bulk of a single bull sea lion — the ruler of the harem.

The bull held his head pointed high even in sleep, dominating the scene like the spire of a high village church. His nose was pointed to the sky as he let the sun beat against the muscles of his huge chest; and eyes set below the knobbed dome of his head opened now and then, just a narrow slit, to see that all went well in the herd. The leathery skin of the old bull *lobo*'s flanks and chest showed wide black slashes, scars commemorating his many battles, battles we knew had been fought with challenging males for the possession of the harem ladies.

We moved quietly in the shallows off the beach, setting up the equipment that we would need to photograph the *lobos* when they swam beneath the sea. We spoke in low tones so that we might not awaken the sleeping animals, and we wondered what they would do when finally we roused them. We suspected that when they awoke and saw human strangers, they would

flee in wild flight for the protection of the water. Thinking this, we positioned ourselves in water more than waist-deep just off the beach. To escape to the open sea, the animals would have to pass close by us.

When we were ready we called to the *lobos* — imitating the booming of their own voices — *aaaarrrrr*, *aaaarrrrr*. Hearing the sound, a few of the sleepers opened their eyes and lifted their heads to peer at us. We continued to call. Those that had awakened raised their bodies up onto their flippers and, staring at us curiously, moved awkwardly down the incline of sand toward the water's edge. As they moved, they bumped the bodies of the other sleepers, so that in a moment the

entire herd was alert and hobbling down the sand toward us. Obviously, they were not afraid. Now, we wondered, are they angry? At the water the *lobos* lowered their heads, dove in, and swam toward us like a mob advancing. Only the old bull remained on the beach now. He could not be trifled with curiosity. He stood there, a dark figure on the white sand, and bellowed a deep call after his unruly harem.

The ladies swam to us. We saw that, like the other animals of the Galápagos, they were friends. They milled close around us, diving to peer at our legs and observing us with intent curiosity. One lady, smaller than the rest, swam directly to the camera box, and holding the

thing with her flippers to support herself in the water, peered into the camera lens. To see the face looming up so suddenly in the view finder was startling. I reached out and touched the brown head, scratching behind the eyes, rubbing the dwarfed ears. The fur which looked so soft was surprisingly stiff. This little *lobo* — Baby, we came to call her — was the most forward animal in the herd, and she became our star.

Like the prima ballerina leading her dancers, she directed the others in the lithe movements of a beautiful underwater ballet. Pirouetting, turning, twisting toward and away, arching their supple bodies in the graceful liquid curves of a fantastic dance, the animals performed before our cameras. We watched through the view finders of our machines, thrilled by the actions of our actresses, warmed by their complete friendliness.

We spent an hour that first day photographing the ladies, and many more hours on other days. But presently we saw our dancers turn and swim quickly away out of the zone of our vision beneath the sea. Something had startled them. We looked up in time to see the bull sea lion. He had been studying us from the beach, his anger growing with the increasing familiarity showed us by his harem. Finally he could stand it no longer. With a loud bellow, he charged down the sand and plunged into shallow water off the beach. He came at us in an amazing burst of speed, like a torpedo across the surface of the bay. His back humped up, head out, glaring at us, he came as if propelled by the shot of a can-



▲ USING A CAMERA BOX for underwater photography, one of the cameramen films the sea lions cavorting off the shores of the Galápagos.

▼ WHILE PHOTOGRAPHING THEIR ANTICS, the author was surprised to have a female sea lion come close enough to grasp the camera in her flippers.





▲ THIS GIANT LIZARD, like the other creatures that had not learned to fear man, allowed the photographer to take a studied portrait.



▲ NO BLIND WAS NECESSARY, and good pictures went begging in the undisturbed wonderland of the Galápagos.

non. His shoulders pushed aside a white wave of water like the bow wave of a speeding barge as he charged toward us. We could see into his open mouth. There were sharp heavy yellow teeth like the jaws of an angry bear.

We had no time to think, barely time to act. Our only reactions were ones of impulse. The charging bull was nearly upon us. Like a lion trainer wielding his chair, I swung my camera box between my body and the attacking bull. The 50-pound camera box did not make a good club — it was difficult to swing. But to have something in my hands gave some comfort under the apprehension I felt. Encumbered by the resistance of the water I could not move quickly, but the bull was in his element. I shouted a reply to the sea lion's bellowed challenge and bluffing, moved toward him, returning the charge. Then, swinging the heavy camera box through the water, I clumsily met the attack, striking the bull a heavy blow on the nose. The bull came to a surprised stop. He seemed to stand in the water only a length away, his huge foreparts above the surface, glowering at us, cursing us with tremendous deep bellows; but he did not charge again.

True, the bull sea lion was not a friend, but neither was he attacking

us in the blind charge of fear like the wild things that know man. In the Galápagos we were merely strangers, trespassers. We were, after all, competing with the bull for the favor of his harem. He did not attack us as hated men but as he would attack another intruding bull *lobo*.

Eyes in the Night

That evening our ketch lay at anchor in the protected cove. The beach of the sea lions was now deserted, for they were feeding somewhere far at sea and would not return until dawn. There was a cool sea breeze from off the bay where the anchor light, nodding sleepily with the slow roll of the boat, showed like a bright planet in a sky full of stars. We sat on the beach at the head of the bay, and the sand around us sparkled with the flickering orange glow from the firelight. On a black grate the white sides of a gamefish were sizzling, dropping bright drops of fat to explode in flaming splashes of light on the embers. We sat in the near dark, on a beach where few men had ever been before, and felt that we were being watched by a stranger's eyes. The unsaid thought passed through our minds. It was as if some unknown being were studying us from the outside ring of darkness. Uneasiness

crept over us, but neither of us would be the first to admit it — nor the first to look behind. It was silly — and yet we felt the eyes.

Perhaps it was a soft, flitting shadow cast through the starlight that made me turn. I looked into the wide unblinking eyes of a brown owl that stood on the sand only a few paces away. He startled me, being so close, so intent; and I had to laugh aloud. The owl seemed surprised by this outburst, but it did not frighten him. He stood high up on his legs and, with an exaggerated pivoting action, moved his head from side to side, as if to see us better from all angles. Then he took a short unsteady walk a bit closer. He stood there on the sand, no more than eight feet away, watching us with the intent curiosity of a child. It was no wonder that we had felt his eyes.

In a moment another shadow glided very swiftly across the sand, and on wings as soft and silent as the filtered starlight, another owl dropped to the sand beside the first. Others came now, perching on the rocks and twigs and cactus branches and standing on the beach. They sat in the border of firelight watching us, occasionally changing perches as if to gain some new perspective. They came until we counted eleven. They stood around us in a circle, as



▲ EVERY MAN was his own director in this "no-man's land," and there was no need to carry a folding camp chair.

we had seen the night herons and bitterns do at another camp. They simply stood and watched and seemed, for all the world, to understand what they saw. My partner arose once to fetch more wood and walked toward the circle of watching owls. Like a wave, the birds retreated, awkwardly running on the sand, holding their wings half out to maintain a balance. They kept the distance from which they had chosen to observe us. Eight feet was safe; they would come no closer. The figure returned, carrying the wood into the firelight glow, and the wave of waiting owls surged in again, closing the gap. From eight feet their yellow eyes stared at us.

It was strange to observe this animal curiosity and to find ourselves accepted by the wildlife of this animal land. And because of it, in the

same way that one is charmed by the naivete of a child, we reacted with a friendliness of our own. Many times we might easily have taken a dove dinner by killing the birds with a stick, but we could not do it. In the Galápagos, where animals are unafraid, we found ourselves talking aloud to the wild things around us, as one talks to a pet dog or cat. We called the sea lions by imitating their grunted barks, and they seemed to understand and came to us. We gave names to the penguins — George, Mr. Peepers — and, absurdly, we found ourselves talking to them with human words but imitating their own voices: "Smoke cools, smoke cools." We talked to the owls, and they seemed to answer us with a prolonged whistling note, a half-screech.

The owls stayed on the beach

watching us until we finished eating and climbed into the skiff to row to the boat. Then, as we rowed across the still water of the bay, they took wing and followed us, circling around the slowly moving skiff, hovering above our heads. When we climbed aboard the ketch, all eleven of them found perches in the rigging and on the superstructure of the boat. We sat on deck for awhile, talking to them, enjoying with them the friendship of this rare experience. We thought how strangely out of place owls were at sea. And finally, when we said good night to them and climbed down the companionway into the cabin of the boat, they were perched in the rigging all around. Closing the hatch must have discouraged them, for an hour later, when I poked my head up to look, they were gone.



▲ THE AUTHOR, engrossed in the actions of two of his subjects.

Tilapia -

THE BROODING FATHER

He carries the eggs in his mouth until they hatch; and if males are absent at mating time, one female will court another

By LESTER R. ARONSON

*Chairman and Associate Curator, Animal Behavior,
The American Museum of Natural History*



John Polo

◀ A BATTERY of television cameras and technicians recording the strange behavior of the West African Mouthbreeder for the American Museum's *Adventure* program.

Kingsley Noble at the American Museum of Natural History. Dr. Noble placed them in tanks in the newly built greenhouse on the roof of the Museum's African Wing. This was about 1936. Here the fish bred prolifically, and the large stock that was established has been maintained ever since.

In 1941, having completed a series of studies on reproductive behavior in frogs and toads, I became intrigued by the unusual spawning habits of these West African mouthbreeders and decided that I should give them some attention. I have been studying them ever since, and the end is nowhere in sight.

I started my project by selecting mature males and females of equal size from the 80-gallon stock tanks. One pair was placed in each of several fifteen-gallon observation aquaria. Apparently some of the *Tilapia* did not see eye to eye with my arrangements and preferred instead to fight. These fish were promptly separated. However, most of the pairs eventually accepted the situation and started the preliminaries to mating.

Their courtship consists of a number of distinct behavioral acts, to which we have given descriptive names. Thus, the male and female approach each other and dip their heads (head-nod), or puff their throats and spread their gill covers (throat-puff), or vibrate their

IN 1941, when I first started peering into the reproductive habits of this fish, its name was scarcely known except to a handful of zoologists and a small group of aquarists who had advanced beyond the guppies and swordtails. Less than twelve years later, we find *Tilapia* known to farmers from Indonesia to the Philippines and from Haiti to Africa. It has even been on special sale at Macy's!

Its widespread appeal to fish farmers stems from the discovery that these fishes are exceptionally prolific breeders. Further, they will thrive in the tropics in all sorts of otherwise inhospitable waters, such as rice swamps, salt marshes, or even city drainage ditches. Above all, tilapias can provide tasty dishes even for the gourmet.

The name *Tilapia*, which is accented on the first "a," with the sound of either *lay* or *lap*, was coined by a zoologist, Andrew Smith, over 100 years ago. He did not apply it to a single kind of fish but rather to a group of related African species which now number almost a hundred. The native African tribes have local names for these, but there are no English equivalents, and most are known only by the technical names given to them by the taxonomists.*

The one I am describing here is *Tilapia macrocephala* (also called *T. heudeloti*). It is the predominant fish of the group along the coast of West Africa from Senegal south to Gabon. While it does not grow as large as some of the others and is therefore of less interest to fishery workers, it does form a staple in the diet in many coastal villages.

In the early twenties, when the aquarium hobby in the United States was still in its infancy, *Tilapia macrocephala* made the long journey across the Atlantic, probably via Europe, to America. Here it was christened the Large African Mouthbreeder, or the West African Mouthbreeder, and later, the Black-chinned Mouthbreeder. As these names imply, this fish has rather unique breeding habits, which prompted the dean of American aquarists, Mr. William T. Innes, to send a few individuals to Dr. G.

Kinds and Uses

* *Tilapia mossambica*, sometimes called the large-mouthed kurper or bream, is considered to be most useful for stocking swamps and artificial ponds. Its virtues are being popularized enthusiastically by the Food and Agricultural Organization (FAO) of the United Nations. *Tilapia esculenta* and *Tilapia variabilis* are caught in huge quantities in the vast expanses of Lake Victoria and other large East African lakes. *Tilapia Galilaea* is found in the ancient Sea of Galilee, the Nile, and across Africa to the Niger and the west coast. It is especially good eating. *Tilapia melanopleura* is considered a game fish in the Zambesi River of the Rhodesias and is there called the red perch.

➤ HOME AQUARISTS who look beyond conventional types find *Tilapia* an interesting oddity. This view was taken in the Museum's smaller aquarium.

bodies (body-quiver), or slap each other with their tails (tail-slap).

As with so many other animals, courtship is not always a smooth and peaceful process. At times it is characterized by periods of violence. Sometimes the fish nip their partners so strenuously that scales fall off and fins are frayed. Occasionally they lock jaws in violent strife. After a time, the nipping or fighting will yield to another span of peaceful courtship.

Eventually the pair selects a spot and builds a nest. The male and female scoop up mouthfuls of gravel and, moving forward a few inches at a time, spit out the loads at the periphery of the nest. They handle large pebbles individually and generally move them a greater distance than the small ones. The nests are saucer-shaped, round or slightly oval, and about one inch deep by four to five inches wide, though the size varies. Occasionally pairs will construct two or three nests, shifting their building activities back and forth from one to another. In these cases the observer, anxious to know in which nest the eggs are to be deposited, may be kept guessing until the very last minute.

Once the nest is completed, a new behavior appears. One fish or the other now swims head-down in an almost vertical position and laboriously mouths the bottom of the nest. This has been labeled "nest cleaning," since we suspect that noxious material clinging to the bottom of the nest is removed by the process.

Now comes another behavior, nest-passing. The male and female swim very slowly over the nest, one at a time, gently rubbing their genital papillae on the bottom. This behavior gradually becomes more



John Polo

and more intense as the male and female await their turn at the nest. During some of these nest-passes, the female will stop for a moment or two, and her body will be seen to quiver. This is the long-awaited sign that the egg-laying is not far off. A few more nest-passes, and then, during one of the spawning-quivers, a batch of about 20 large golden-yellow eggs, about the size of small grape seeds, are forcefully ejected from the orifice of her genital papilla.

The female then swims from the nest, and the male, who has been patiently waiting behind her, swims over the newly laid eggs and spreads his sperm-containing milt over them. By this time the female has circled around behind him, and as soon as he moves on, she swims in and deposits a second batch of eggs. The male promptly fertilizes these, too. These procedures may be repeated two or three more times until all the eggs are laid.

Then the male returns to the nest once again but this time to suck up the eggs into his mouth. Within a minute, the eggs are all gone from the nest. Many hours of continuous and painstaking labor

have been invested in a nest that is used for only a few critical minutes. But this is well worth the effort, for the eggs are all together in a protected spot and the male seldom misses any unless, of course, he cannot pack them all into his mouth. In that case, the female usually gathers up the leftovers.

From Egg to Small Fry

The eggs are carried in the mouth of the male or female for 8 to 20 days, the average being about 2 weeks. During this time, the embryos develop into small fry, and the nutritive yolk is gradually absorbed. When finally released, they are fully formed little fish, about $\frac{1}{2}$ to $\frac{3}{4}$ inch long and fully capable of fending for themselves. This they must do immediately by swimming into tiny crevices, such as the interstices between plants. Otherwise they will be eaten, especially by the faithful father who has just released them. You may consider such behavior reprehensible, but remember that the male has eaten little or nothing during the entire incubatory period. Actually, most of the baby fish are able to make their escape.



One of the greatest advances in the science of animal behavior in recent years has been the adoption of quantitative methods. Formerly, students of behavior were satisfied with simply describing what animals did in given circumstances. Now behaviorists like to know how many animals in a group will act in a similar manner, how much their behavior will vary from individual to individual, and how many times an animal will repeat a certain act under specific circumstances.

After watching a number of spawnings, I felt that I understood and could recognize the various courtship, spawning, and parental behavior patterns. I then started taking quantitative records on many pairs of fish, using a stop watch and tally system to record the frequency of the various behavioral items. In doing so, a number of interesting features in the reproductive behavior of *Tilapia* were uncovered.

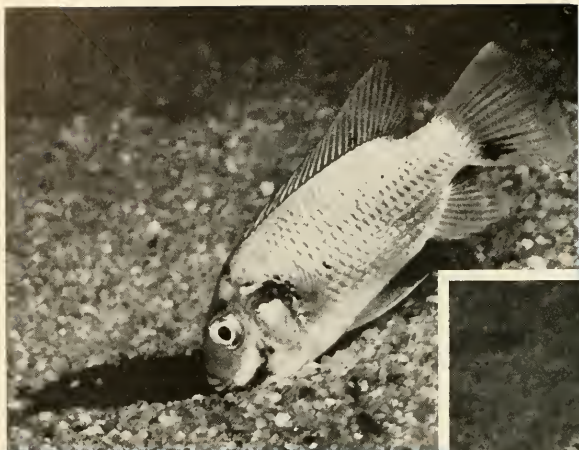
In many animals, the normal sexual behavior of males and females is so different that it is possible to refer to male behavior or female behavior. This is not true



▲ CAREFULLY TENDED IN THESE TANKS, the *Tilapia* that were given to the American Museum's Department of Animal Behavior in the middle thirties have thrived and multiplied.

in *Tilapia*. The reproductive patterns of the male and female—head-nodding, throat-puffing, body-quivering, tail-slapping, nest-building, and nest-passing—are all the same for both sexes. Even the motions involved in egg-laying and fertiliza-

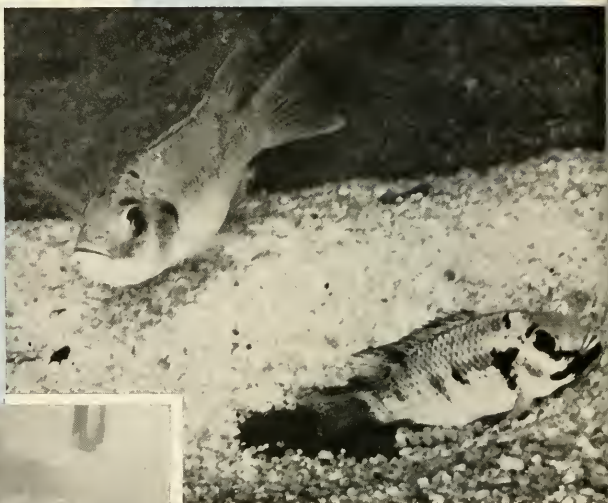
tion are exactly similar, and as we said before, both the male and the female will pick up eggs and incubate the young. However, when the tally sheets were examined, a new pattern came into focus, for it was seen at once that the two sexes per-



◀ CLEARING THE NEST. Both male and female take part in this operation.

▼ HERE the female is laying the eggs.

▼ SHORTLY after they are laid, the male passes over the eggs and fertilizes them. If two females are "courting," one of them performs even this movement.



➤ THE MALE is now picking up the eggs. The female may also pick up some but less energetically, and she is more apt to swallow them.



formed these behaviors at vastly different rates.

The female performed most of the early courtship patterns much more frequently than the male. On the other hand, the records showed more nest-passes for the male than for the female several hours before spawning; but as the time for egg-laying approached, this relationship became reversed, with the female doing much more of the nest-passing. The same was true for spawning-quivers. When eggs are in the nest, both males and females will pick them up, but a male will tackle the job almost immediately, while the female will dawdle. She may act very disturbed by the presence of eggs, but she will not pick them up for at least five or ten minutes. That is why one usually sees males performing the parental chores; they simply get to the eggs first.

Some Eggs Swallowed

When in special circumstances the male is prevented from picking up the eggs, and the female eventually gets around to the job, it still takes her several minutes to gather them all up. The male can do this in a matter of seconds. Also, the male incubates the eggs more efficiently. He often errs, to be sure, and swallows a few. Occasionally, after carrying his precious brood

for a few hours, he may swallow them all. But the female is much more prone to swallow eggs than the male, though I have seen a few females care for a brood just as effectively as do the males.

Thus we see that our quantitative observations have brought to light a number of differences between the sexual behavior of males and females, and this paved the way for several interesting experiments.

I was particularly anxious to know what would happen if I violated customary procedure and established pairs consisting of two adult females. When I did this in a number of aquaria under observation, my female-female pairs soon started courting each other. Once more I resorted to the stop watch and tally sheets. Having selected fish with slightly different markings, particularly on their backs, I could easily distinguish them and so could record the behavior of each female.

It was not long before I was able to detect marked differences in the frequencies of the several courtship patterns. One fish was performing at the female rate and the other at the male rate! Indeed, the difference was so evident that before the actual spawning occurred, I could tell which fish was the "acting male." In every case I proved correct. When the functional female

laid the eggs, the "acting male" always swam over the eggs as if spreading milt over them. Of course, the "acting male" did not possess sperm, and the eggs were therefore not actually fertilized.

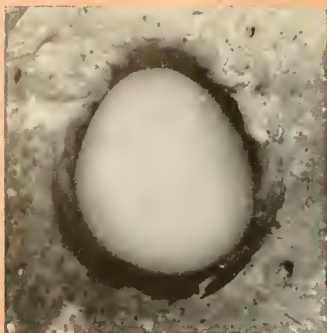
From then on the situation was a little confused. Both fish were slow in approaching the eggs. They eventually did pick them up, but in most cases the two females shared the brood more or less equally. Since the eggs were infertile, they soon deteriorated and disintegrated.

These observations are important because they contribute to the already mounting evidence that bisexual behavior (or homosexual behavior, as it is commonly called) is a very widespread phenomenon in the animal kingdom and must have appeared very early in the history of backboned animals. More important, what kind of behavior appears may depend largely on particular circumstances at the time—in this case, the pairing together of two females. Like other animals, fishes are able to respond to events in their surroundings. Their behavior is not nearly so rigid as is sometimes supposed.

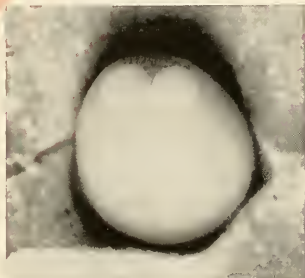
In studying the ways of animals, there is a great temptation to assume that the behavioral repertoire of one species will be the same, or at least very similar, in closely related forms. This is not always the case. In many species of *Tilapia*, for example, the female usually or always incubates the eggs, and there are several other differences in the spawning procedures. So the reader must not be surprised if he reads elsewhere that Madam *Tilapia* sometimes assumes the conventional role of the brooding mother.



◀ THE EXPANDED THROAT shows that this male has a mouthful of eggs. He goes hungry for as much as 20 days while carrying them. When the young fish hatch out and swim away, he may try to eat a few.



▲ ZERO HOUR: The one-celled egg, a little less than one-eighth inch long, bears no resemblance to the adult fish. At the tip end is the protoplasm. The rest is nutritious yolk.

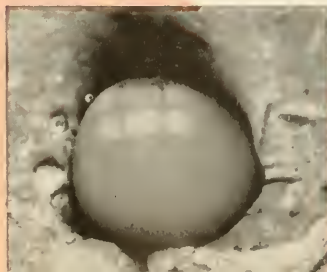


▲ ONE HOUR: The protoplasm has become two cells, separated by a deep furrow.



▲ TWO HOURS: Each of the two cells has divided again, making four cells.

▼ THREE HOURS: Once again the cells divide, and there are eight of them across the surface of the yolk.



Two Weeks in Father's Mouth

The camera catches *Tilapia* in its dramatic change from egg to young fish

By EVELYN SHAW

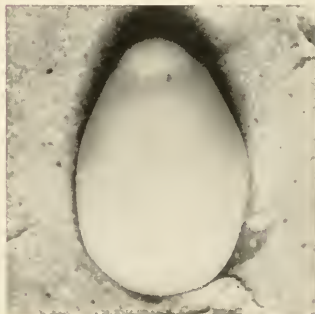
THE changes that occur in all fish eggs, molding and shaping them into young fish, are fascinating and intriguing to watch. It is not easy to follow these changes in *Tilapia* eggs while they are protected in the cavern of father's mouth, but with gentle squeezing, the male unwillingly spits them forth. After gathering them and placing them under a microscope, we can peer through its magnifying eyes and see the smooth, rounded exterior of a newly laid egg.

The egg is about the size of a small grape seed and is yellow and yolk. It is encased in a transparent shell, the chorion. The yolk, which makes up most of the egg, is the food supply of the growing embryo, much as some of the substance of a seed provides food for the sprouting plant. At the narrow end of the egg is the tiny but important ac-

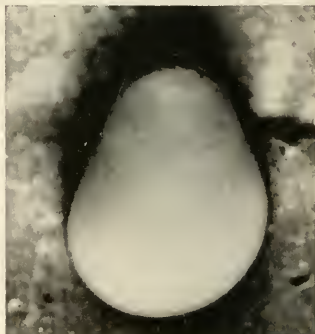
cumulation of living material, the protoplasm. This small dotlike cell, barely visible to the unaided eye, is the first in a series of millions of cells that will form the new fish's body.

There is no inkling of the complex physical-chemical structures within this seemingly homogeneous mass, which would disintegrate to nothingness if it were not triggered by the headlong penetration of sperm into its substance. It is this triggering mechanism that initiates development as the protoplasm of the sperm and egg mix. While we watch, the protoplasm seems to vibrate and seethe with activity, heralding the beginning of a new generation.

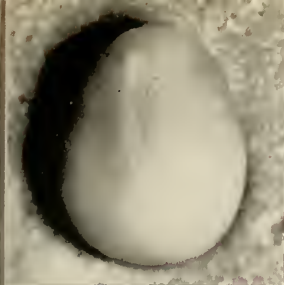
In the accompanying photographs, we see the highlights of the changes that occur during the two weeks the embryos spend in the father's mouth.



▼ ONE DAY: Some cells slip over the side, and more follow, flowing over the yolk and surrounding it.



▲ SEVEN HOURS: The number of cells has increased so greatly that they are too numerous to count. They are perched on top of the egg and seem to be crowding one another.

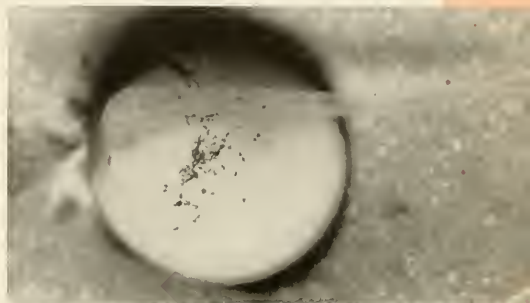
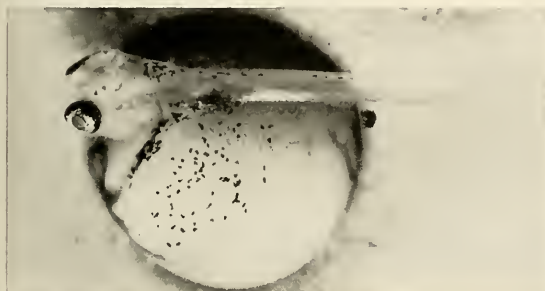


ONE AND ONE-HALF DAYS: A long, slender thickening has appeared on the face, the very first signs of our new life.



◀ TWO DAYS: This slender bar, broader at the head end, soon shapes into eyes, ears, nerve cord, and digestive system. Black pigment cells, which give the adult fish some of its color, are spotted over the yolk.

▼ FIVE AND ONE-HALF DAYS: The surface of the yolk is entwined with a network of blood vessels, bringing nourishment to the embryo, which is now one-fifth inch long. The yolk shrinks steadily, pulling the heart gradually inside the body. Black and gold pigment cells dot the body and are densely packed in the glistening eye.



▼ SEVEN DAYS after the sperm first penetrated the egg, the young fish breaks out of its shell, in no way resembling the small mass of protoplasm that was its beginning. It spends the next eight or nine days using up its food source, the yolk, and becoming more like its parents.

▼ TWELVE DAYS OLD: These odd-looking small fry still carry their own food supply, the bulging yolk sac. Part of the sac is covered by the stomach wall.



▼ FIFTEEN DAYS OLD: When they are released from father's mouth, they resemble the adults. They must forage for their own food, but they are fair game for other fish, including their own parents!





★ THE SKULL OF MIDLAND MAN, painstakingly pieced together by Dr. T. Dale Stewart of the U. S. National Museum. Age: probably between 9000 and 12,000 years.

MIDLAND MAN

The story of what are believed to be the oldest skeletal remains yet discovered in North or South America

By ANNETTE H. RICHARDS

All photographs courtesy of the Museum of New Mexico

KEITH GLASSCOCK, a pipe welder from Pampa, Texas, was an off-hour hunter of relics. The discovery he made on a Sunday in June of 1953 hit the headlines and made history.

As on many previous trips, his wife and children accompanied him that afternoon on a search for chipped flint weapons on the ranch of Clarence Scharbauer near Midland, Texas. Suddenly, his oldest son, Pat Keith, aged 12, picked

something out of the sand and held it up for his father to see. "Say, Daddy, isn't this a piece of *human* bone?"

After examining it, Glasscock felt sure his son was right. Knowing that the area had yielded Folsom points, representing one of the oldest cultures in North America, he wondered whether this bone might not be very ancient. But not till he had found part of the upper dentition was he convinced it was a

human skull. He also collected two hand bones, a first rib, and two projectile points showing human workmanship.

What he did next entitles him to the undying gratitude of professional archeologists everywhere. He left the stuff just where he had found it, except for the loose fragments that might have been crushed by grazing cattle or blown away by the wind. He marked the location and notified a qualified

archeologist, Dr. Fred Wendorf at the Laboratory of Anthropology in Santa Fe, New Mexico.

When Dr. Wendorf saw the fossilized state of the bones, his remarks tended to confirm Glasscock's judgment. This handful of skeletal fragments might well date from the Ice Age! Previously, Folsom Man had been known only from objects showing his workmanship, not from any skeletal remains. If it could be proved that this individual belonged with the remains of the Folsom culture, it would mean that he roamed the Southwest when it was green and lush 10,000 years ago, and he might be the oldest human being ever found in North America.

Appreciating the potential importance of his discovery, Glasscock again showed his respect for science by loaning his entire collection of bone fragments to Dr. Wendorf.

Archeological wheels grind slowly. Excited as Dr. Wendorf was by the find, he could not go personally to Midland, Texas, until the following fall.

It was on October 28, 1953, that he joined Glasscock, Dr. Alex D. Krieger, research archeologist at the University of Texas, and others in a preliminary expedition. They found additional skull fragments, another rib section, and other artifacts. They drew maps and dug test archeological trenches. But now the excitement grew even more intense, for

the bones seemed to lie at an even older geological level. This might mean that the skull was not Folsom Man but a predecessor!

Prompt action was necessary to protect the site. One of the most perishable things is an archeological excavation. Sun, wind, rain, animals, and (worst of all) amateur treasure hunters can easily destroy evidence that can never be restored. A full-fledged drought was in high gear, and wind-blown sand was the number one problem.

Piltown Man had recently been proved a fraud, and nobody was going to fumble this job. The archeological world had been set agog by Midland Man, but all agreed that the site must be given careful and



◀ KEITH GLASSCOCK, pipe welder from Pampa, Texas, at the spot where he and his son found the first fragments of Midland Man's skull, hand bones, and ribs.

▼ THIS CAREFUL TRENCHING helped to establish Midland Man's position in the chronological sequence. In the nearest trench, close to the measuring stick, can be seen the clear line of demarcation between the red and gray Judkins sand layers. Midland Man's bones were found in the gray layer. Folsom points were found above the red layer, and recently one fragment appeared in the gray.





◀ IN THIS CLOSER VIEW of the preceding scene, Edward Moorman, who assisted Dr. Wendorf, is pointing with his trowel to the line between the red and gray layers. This is deduced to represent the beginning of the dry period.

▼ HERE THE TAN MONAHANS SAND superimposes the red layer. Folsom Man lived at the level between the two.



▼ AN EXPOSED SECTION showing the same separation between the red and gray sands in the blowout in which Midland Man was found.



thorough study before any conclusions could be released for publication.

A few months later, in February, 1954, a second expedition was organized. Dr. Claude C. Albritton, geologist and dean of the faculty of Southern Methodist University at Dallas, conducted detailed stratigraphic studies of the trenches opened by the archeologists. Could shifting sands have played a trick? By checking and rechecking Midland Man's geological placement, the scientists tried to make doubly sure that he was really older than any indication of Folsom Man in that area. They also found more samples for dating by chemical methods.

Skull Reconstructed

The task of fitting together the hundred or so skull fragments was assigned to Dr. T. Dale Stewart, Curator of Physical Anthropology at the United States National Museum in Washington, D. C. Under his expert fingers, the splintered pieces formed an almost complete skull, except for most of the face and base.

Samples were given to Dr. F. J. McClure of the National Institute of Dental Research for the same fluorine tests that had exposed Piltown Man. If the fluorine content of the bones proved to be the same as that of animal specimens from the same soil—animals known to have been extinct since glacial times—Midland Man's antiquity would be confirmed.

Months passed. Finally, a full year after the initial discovery, the long-awaited word came from Washington. The judgment of the

archeologists was corroborated. The public could now be told. On Independence Day, 1954, Dr. Wendorf and Dr. Krieger announced the discovery of the "First American." Soon people across the land read in the papers of a man older than the Folsom culture. Midland Man's age? "At least 12,000 years," was the estimate, "... maybe much older." Materials from the era of Folsom Man had already been dated by Carbon 14 at about 8000 to 10,000 B. C. Midland Man's skull, rib, and hand bones lay *beneath* the lowest Folsom relics that had been found in this area.

Davy Crockett may have been "King of the Wild Frontier" in his relatively recent day, but he probably had an easy time compared to Midland Man, whose frontier was really wild. Davy had a rifle to help him kill his "b'ars," but this prehistoric man was forced to hunt huge, now extinct bison, horses, and four-horned antelopes with hand-made spears.

The region where Midland Man once hunted those animals of the past is today a Dust Bowl. But where blinding dust storms now sweep across the lone prairie, moist and mild climatic conditions existed in Midland Man's time, favorable to the existence of many animals. His bones, in fact, actually lay in an ancient lake bottom, as snails and ostracods testify.

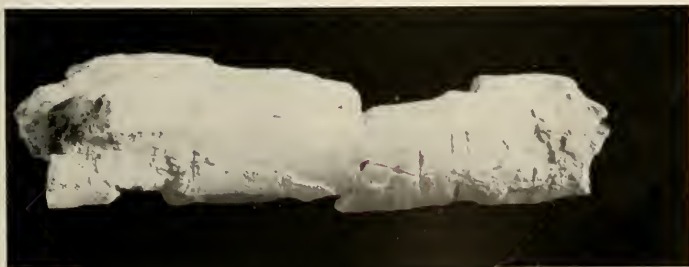
The Midland dig was located in an isolated cluster of five sand dunes, a mile by a mile and a half in extent, on an otherwise featureless plain about 2600 feet above sea level. The remains were found in the bottom of a blowout, a sort of horseshoe-shaped basin 500 feet

across, opening toward the south.

One of the exciting events of this dig was the discovery of a hitherto unknown dry period which seemed to separate the wet period of the Midland bones from that of the Folsom relics. Analysis of the layers exposed in the trenches showed this drought. Starting from the top, successive layers of sand were disclosed—tan, red, gray, white. The top layer, known as Monahans sand, is the most recent and is easily blown about by high winds. The next three layers, all of them Judkins sand, are more stable. In the particular blowout where the bones were found, the wind had carried away the two upper layers and some of the third. It was in the gray sand on top of the fourth layer that the skull, rib, and hand bones were found. What interested the archeologists was the drought layer shown by the red sand just above this gray sand.

When was this drought, and how long did it last? A bit difficult to say, but on the basis of what had been found up to that time, the experts felt that it might have lasted from 2000 to 10,000 years. Only last fall, however, new evidence came to light, of which there has been no official announcement. A basal fragment of an unfused Folsom point was found in the gray sands that contained the skeletal remains. This seems either to push Folsom Man back further or to bring Midland Man up to the earliest Folsom levels.

Welcome but not surprising evidence was also found in the presence of hearths. Burned bones included a four-horned antelope. This animal supports the conjecture that



◀ THIS FIVE-INCH PIECE of fossilized bone from a horse's leg was found even below the layer in which Midland Man's bones were. Marks left on it by the hand of man prove that someone else was there earlier.

the Midland remains fall near the beginning of the Folsom horizon. Investigations will continue as funds become available.

The further back archeologists probe, the scarcer becomes the evidence of human life on this planet. Textiles decay, wood rots, houses crumble, and very little besides fossilized bones and stone implements remains. However, scientists can sometimes deduce a lot even from these few remnants. The layers of accumulated material in which artifacts are found help place them in the time scale and reveal whether they were used in a dry or wet climate. Charred stones from ancient hearths tell of the knowledge of fire. Organic material (but not fossilized bone) can be put through the Carbon 14 test. The shape and size of crudely chipped stone points show how the ancient people hunted—by spear or by bow and arrow. The remains of extinct animals disclose the kind of meat they ate. And fossilized human bones—the most highly treasured prizes—reveal what manner of man left the traces.

We can hardly complain at America's being called the *New World*, quite apart from the renegey of Columbus' discovery. Human remains far older than any we can claim have been found in considerable abundance in other parts of the world. Fully a score of localities in Europe and adjacent lands have yielded skeletal material belonging to Neanderthal Man, a human type believed to have lived somewhere between 25,000 and 50,000 years ago. By far the most ancient human remains have come from Asia. Ages ranging from a quarter of a million to a million years have been assigned to Java Man (*Pithecanthropus erectus*), discovered by Dubois in 1891 and amplified by von Koenigswald since 1936. Also exceedingly old are the remains of 30 or 40 individuals found at Choukoutien, China, the site made famous as the home of Peking Man. And there have been innumerable other important skeletal finds in Asia, Africa, and Europe.

During the million years, more or less, since the earliest known people lived in Asia, man has undergone definite physical development. But the Western Hemisphere has produced traces only of the relatively modern type we call *Homo sapiens*. In Europe, the famous Cro-Magnon race, which lived 10,000 or 15,000 years ago, was a representative of this type.

The Star Witness

A battle royal was waged among archeologists in the first half of the twentieth century over the question of whether man could have been in the Western Hemisphere before the retreat of the last great glacier, which is now known to have begun 10,000 or 11,000 years ago. A truce was called in 1926 when a number of discoveries in the western part of our country offered indisputable evidence of at least a modest antiquity for man in the New World. The star witness was Folsom Man, who, although he himself has remained an anthropological ghost, left numerous calling cards in the form of characteristically chipped stone points. His specially shaped and finely made projectile points usually have an unmistakable shallow groove chipped down the side of the blade. Folsom Man roamed widely over the central plains from Canada to Mexico, and his claim to antiquity is beyond dispute.

Now come actual bones—indeed, a fairly complete skull—from the earliest Folsom horizon.

In the fall of 1954, the third expedition at the Midland site uncovered a campsite with some of Midland Man's actual tools and artifacts in the same gray layer in which his bones had been found. Archeologists also learned two new facts about Folsom Man. They found what they believe are the first stone-lined hearths yet unearthed from Folsom culture. And they picked up *unfluted* points so much like regular Folsom points in outline, size, and chipping that in the future, fluting or grooving may not be considered indispensable in diagnosing Folsom workmanship.

Perhaps the variation in fluting—on one side, both sides, or neither side—was due to the thickness of the stones out of which the points were fashioned rather than to different makers.

Dr. Wendorf and Dr. Krieger describe their Midland Man as the least controversial and most satisfactory find so far in the search for the Earliest American. Still cautious, however, they say, "We're fairly certain of our ground, but we don't want to come right out and say this is the oldest human skull found in this hemisphere." With a grin, tall, young Dr. Wendorf adds, "It would be fairly safe to call him the first Texan." Texas, according to its own claims, has not only the biggest, bestest, and mostest; it now is putting in a strong claim for the *oldest* American skull.

An amusing sidelight of our still predominantly masculine civilization is that, although this archeological milestone is known as Midland Man, it is really a woman! Maybe that is why Midland Man's exact age is still a mystery. If feminine evasiveness in the matter of age is as ancient as it is widespread, the young lady would probably have enjoyed seeing the quandary in which the scientists find themselves regarding her antiquity.

Though Midland Man makes no claim to being the first person to have graced our hemisphere, he appears to be as old as any other skeletal material yet found in North or South America. Other cultures, like Sandia, Clovis, and the recent Nevada discoveries, have left evidence of more ancient human life in America. But as of this moment, no other human skull on record in America can prove itself older. And as fossilized human bones are hard to come by, perhaps Midland Man will hold this distinction for some time.

★—————★

For valuable advice in the preparation of this article, the author and *NATURAL HISTORY Magazine* are indebted to Claude C. Albritton, F. J. McClure, Harry L. Shapiro, T. Dale Stewart, and Fred Wendorf.—Ed.

The Vine that wouldn't Stop Growing

This veritable Jack-and-the-beanstalk among Wistaria vines has already smothered one ten-room house and is clutching at another in its march to fame as one of the horticultural wonders of the world

By AUBREY B. HAINES

IF TOLD that near Los Angeles there is a single vine whose weight is estimated at 225 tons, you might suspect a joke. Yet at the foot of Mount Wilson, on the outskirts of the suburb of Sierra Madre, you can see this unbelievable Wistaria vine, and its beauty is proportional to its gigantic size.

It covers approximately an acre and is growing larger and heavier each year. Innumerable trellises and arbors help support its magnificent branches, and during its blossoming season—usually in late March and throughout April—one and a half million lavender blossoms hang overhead in grapelike clusters. This present season will mark its sixty-fourth year of growth.

The story of how the Sierra Madre Wistaria came to be planted is an amazing one. At first it was no different from any other. Back in 1892, Mrs. Alice Brugman traveled five miles by horse and buggy to Monrovia, where she bought a Chinese Wistaria seedling in a gallon tin can for 50¢ at a nursery. Transplanting it in a spot near the front porch of her home at 201 West Carter Avenue in Sierra Madre, she remarked to a neighbor, "I hope that it will grow to cover my house. Per-

haps it will in about 20 years. Wistaria is said to grow fast."

Mrs. Brugman did not have long to wait. First the vine began to cover the porch. Soon it stretched itself up the side of the house to the roof. Then it forced the windows and the doors. To hack away at the rapidly extending branches appeared useless; and finding this out, Mrs. Brugman determined to sell the house and the vine.

Some people looked upon the plant as a monstrosity, but its new owner, Henry T. Fennel, was entranced by it. He claimed that he could almost hear the vine growing on hot summer nights. The noise was probably from snapping shingles loosened by the plant's creeping "tendrils." Though botanists may doubt the figure, actual measurements at this time are said to have revealed that the Wistaria was growing as much as 10 inches in a single 24-hour period.

But Mr. Fennel's entrancement soon gave way to astonishment when he found that he must soon abandon the ten-room house he had purchased and build another one. He was careful to have his new house constructed 200 feet from the vine's main stem. A portion of

the old house still stands as the basic support for the vine, and a bronze plaque marks the spot where the original plant got its start. But today the vine is not content with the title of the world's largest Wis-

taria; it is clutching at the new house.

The next owner of the gigantic plant was Mrs. Carrie Ida Lawless, one of the vine's greatest admirers. Because of the tremendous cost of

maintenance, the vine and its surrounding land had not been fully developed. Mrs. Lawless spent more than \$100,000 to beautify the expansive grounds and develop them into the Wistaria Vine Gardens.

In later years the huge plant was acquired by Richard Thayer, who had planned to chop it down because of the cost of upkeep. The grounds were to be subdivided into homesites. But individuals and organizations throughout the country protested, and the vine was given a new lease on life through the formation of the Wistaria Vine Association. This organization has assumed the full responsibility for managing the affairs of the grounds.

Keeping alive the monstrous Wistaria is an exacting business. During the past ten years the cost of maintenance has reached as high as \$10,000 a year. Besides taxes on the property, this money is spent for maintaining a year-round gardener, who is aided for nearly three months of the year by three experts in pruning.

Since 1914, more than half a million persons have visited the huge vine. It is the world's largest blossoming plant. Some of its branches measure 500 feet in length, and it normally produces 40 blossoms to the square foot. Underneath the gorgeous bowers there are picnic tables and easy chairs, where visitors may enjoy the coolness of the spring day.

Scientists, endeavoring to explain

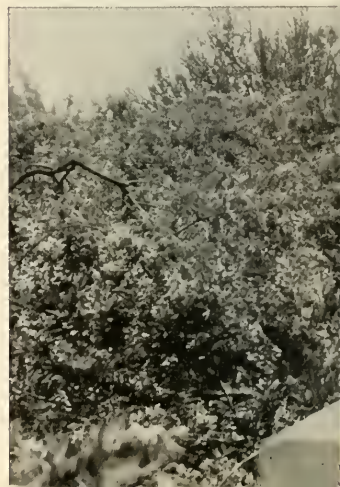


▲ PLANTED 64 YEARS AGO, the vine now covers an acre and attracts tourists from all parts of the world.



▲ WHEN ITS EXTRAORDINARY GROWING-POWER was realized, the Wistaria Vine Association was formed to care for it and provide facilities for the visiting public. Since 1914, more than half a million persons have visited the spot.

➤ THIS VIEW from the porch of the house shows only part of the giant Wistaria. It is now fed vitamins and fertilizer.



the difference between the temperature within and outside the garden, claim that the plant expels so much water that it probably lowers the temperature several degrees. Also, the vine and blossoms keep most of the sunlight out. Water is run all day and night, but the roots are so thirsty that none of the water remains long on top of the ground.

In recent years new plants have been started, and now the lavender blooms are intermingled with pink and white ones, thus enhancing the beauty of the display.

The Wistaria Garden has been open to visitors since 1914. In 1918, when the plant was featured in a Red Cross benefit for World War I relief, 12,000 persons visited it. It has now become a veritable flower-lovers' shrine. Each year as many as 30,000 people see it during its four- to six-week blossoming season, to marvel at the gorgeous array of flowers and enjoy the long, cool paths, almost entirely shaded from the sun. Visitors from every state in the country and almost every nation on the face of the earth have walked under the trellises. One of the most famous recent visitors was Trygve Lie from Norway, former Secretary-General of the United Nations.

For the past 41 years, an annual flower festival has been held in connection with the blossoming of the plant. Here a queen and her princesses are chosen from among many girls between the ages of sixteen and nineteen. The judges are

the presidents of various men's and women's service clubs in the city.

It was Fennel who developed and trained the giant Wistaria. But during the 1930's, Mrs. Lawless developed the grounds. Here she spent a fortune on landscaping and setting out rare plants, both native and tropical. She also installed metal arbors and supports for the vine and made extensive additions to the arbors, allowing the plant to spread over the greater part of the property. The vine is beginning to envelop a 90-foot oak tree. Root "croppage" has been discovered as far away as 265 feet from the place where the vine was first planted. The giant plant is fed with huge quantities of manure and given "shots" of plant food at various key points.

Ranks with the Finest

Today the Sierra Madre Wistaria is ranked as one of the horticultural wonders of the world, among which are usually included the gardens at Buckingham Palace in London, Mexico's Floating Gardens of Xochimilco, Japan's Yokohama Rock Gardens, and the Shalimar Gardens of Kashmir.

Every year the Wistaria gardens and the Sierra Madre Chamber of Commerce answer hundreds of inquiries from people who have come from all over the United States. Last season some of the inquirers stated that they were coming to see the gardens for the twenty-fifth time! Such is the devotion people exhibit for this giant plant. A few religious persons make the pilgrimage each year in order to engage in prayer; others come to sit for hours under some nice bower with a favorite book.

Flower lovers may be interested to know that the Chinese Wistaria is excellent for landscaping. It grows fast, covers bare areas, and is one of the liveliest of blooming plants. It grows best in the sun or in partial shade. For background planting, however, it must be pruned and trained during its first few years. In planting Wistaria, it is best to allow at least 20 feet of space for one plant. For a good start,

the ball of roots should be planted in a mixture of two parts of manure with three parts of garden soil. The plant should be fed with a plant food a month or two before the blossoming season, and two feedings a year will keep a vine in good condition. The Wistaria thrives best in the temperate zones, although it can grow in such different climates as that of Southern California and the New England States.


Botanists marvel at the growth rate of the Sierra Madre vine. Earlier owners hired several gardeners to give the plant hypodermic injections of Vitamin B₁. Strangely enough, the Wistaria makes its greatest growth after a cold winter followed by a sudden hot spell. It also produces the greatest number of blossoms under these same conditions. It is said that in 1949, by actual measurement, the vine grew 26 inches in a 48-hour period. One year, when Mrs. Lawless owned the plant and wanted to withhold the blooming till the desired time, gardeners packed it in ice.

Beneath the overhanging bowers of the plant is a souvenir stand where the visitor may purchase Wistaria stick cologne and perfume. A swimming pool, lounges, and chairs are near by. Each Easter Sunday, sunrise services are held under the vine, sponsored by the Sierra Madre Ministerial Union. All the principal churches in the city participate, and between 500 and 600 persons usually attend.

The vine gardens are open to the public from ten in the morning until six at night during the blossoming season. Admission is 50¢. A tearoom serves light lunches. Transportation to Sierra Madre from Pasadena or Los Angeles may be acquired from Metropolitan Motor Coach Lines.

Artists and poets have paid tribute to the famous plant, and visitors have called it "the most gorgeous bower of flowers in the Western Hemisphere." The Wistaria vine itself disproves that modern people have no time for mere beauty.





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THE MYSTERY OF THE MIMA MOUNDS continued from page 139

been considered as the agency that might have produced them, but such a process acting alone would destroy the mounds rather than form them. So the real answer went begging until it was realized that the cores of each polygon must have been frozen, which saved them from destruction.

Troy L. Pévé of the U. S. Geological Survey threw in his lot with Ritchie. He had observed similar mounds near Fairbanks, Alaska. He said that field studies of permanently frozen ground showed that ice masses occur in networks but that when these masses melt, mounds are formed. At first he believed, like Newcomb, that the ground between the ice wedges sank down into the depressions left by the melted ice. He now agrees with Ritchie that erosion was all-important in the final development of the mounds.

The Gopher Theory

Oddly enough, all during the past decade or two while these noted geologists were scientifically arriving at the solution, two local scientists were explaining the mounds in an entirely different way. Their explanation was taken seriously enough to start a big controversy between geologists and biologists. Walter W. Dalquest, of the University of Washington, and Victor B. Scheffer, from the U. S. Fish and Wildlife Service, contended that the mounds were formed indirectly by generations of prehistoric pocket gophers. The gophers were supposed to have migrated into the region shortly after the last glacial period, when the outwash prairies left by the melting glaciers were relatively smooth. The continued burrowing of the gophers in building their nesting places was thought to have loosened the soil so that the growth of vegetation was greatly stimulated, gradually producing the mounds. These scientists pointed out that large rocks, too heavy to be moved

by the gophers, had accumulated at the base of each hillock. This occurred, they said, when the burrowing of the gophers around and beneath the stones permitted the rocks to settle into the earth.

"That novel idea [the gopher theory] left geologists in a position of arguing on what a gopher might or might not do," says Ritchie with a smile. "In view of the knowledge of periglacial geological processes now accumulated, it seems clear that the origin of the mounds is no longer a biological problem, so there is little need to continue to evaluate the engineering aptitude of gophers!" Others pointed out that if all those mounds were built by gophers, they would represent a unique monument to a colony of extremely energetic animals.

Today the gopher theory has given way to the frozen-ground erosional theory. With the airplane and other modern methods of getting evidence, the frost experts claim a clear-cut case. Though observers on foot can see no regularity, airplane photographs show the mounds to be rather evenly spaced in discontinuous rows. This in itself invalidates many of the theories, for whoever heard of ants, buffaloes, or gophers building mounds in rows?

Ritchie recaps many points of evidence in his "The Erosional Origin of the Mima Mounds of Southwest Washington," in the *Journal of Geology*, January, 1953. His explanation has received wide acceptance. It looks as though it is the one that will stick.

At first thought, it would seem a shame that the mystery is solved. For over 115 years, man has had the fun of trying to solve this enigma of nature. Now, no more wild guesses. Suckerfish! Gophers! It was fascinating while it lasted. Perhaps that is the way the Creator wanted it. But after a certain time, the puzzle had to be solved. As any good research scientist will tell you, truth is like gold: the fun is in the finding of it.

Letters

White Crown Deer

Sirs:

In Nara Park, which is famous for its many tame deer, there is one deer that has a white crown, and I offer you this photograph of her.

The park is in Nara-Shi, Nara-Ken, Japan, and the deer are kept by the shrine of Kasuga Jinsha.

The white-crowned deer is a female. She was born in May, 1954. The hair of her crown is pure white and very pretty. The people of Nara-City admire this deer and call her the "Queen of Deer."

I thought your readers might be interested, and perhaps some scientist can explain this.

KAORU MURAI

Nara-Ken, Japan

When two eminent mammalogists at the American Museum were shown the picture of the "Queen of Deer," they admitted that neither of them had ever encountered a phenomenon like this before. "The animal is apparently a Sika deer," said one of them. "Yes," said the other, "but it appears under a new heading."—Ed.

Scorpions

Sirs:

In response to your article "Do Snakes Commit Suicide?" I would now like to ask whether scorpions are known to commit suicide.

In primeval days in Syria around 4000 B.C., the scorpion was depicted on clay tablets, stelae, monuments, etc., as a minor deity and left unharmed. The cuneiform writings of that period state that the reason the scorpion was revered was because it would commit



suicide by its own sting rather than be destroyed by a formidable foe.

R. DE R. BARONDES, M.D.
Veterans Administration Regional Office
Los Angeles, Calif.

The story that the hopeless scorpion turns its fiery sting upon itself to commit suicide is a tradition of many peoples of the world. The great age of this belief is attested by the above reference, nearly 6000 years old. Literary allusions of this type often stem from a few or even a single

source, and are passed on intact from one age to another. And today, right in our own Southwest it is common to hear someone speak of the scorpion's tendency to commit suicide. But to concede that the scorpion actually does so would award the animal reasoning and intellectual faculties which we know it does not possess. The thesis must be rejected in spite of the fact that on occasion a scorpion may be seen to strike its body repeatedly with its own sting. Scorpions are essentially blind, nocturnal animals and know their environment largely through chemo-tactic stimuli associated with touch. When the scorpion seizes prey, it holds it in its pincers and then curls its long tail forward over the back to bring the sting into use far in front of the head. The scorpion strikes in front and to the sides with lightning speed and can be goaded to repeated.



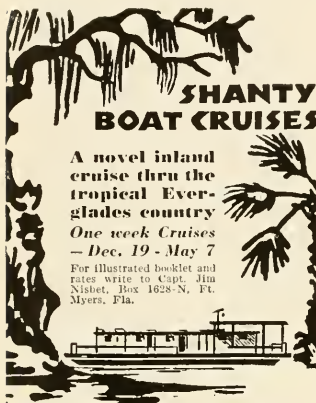
frantic stabbing. Under such conditions of stress, self-inflicted stings are probably not infrequent. I have heard that one of the old cowboy tests of the scorpion was to ring it with fire and wait

for the frantic creature to sting itself. One can easily understand why such a tormented animal would resort, during the process of the roasting, to violent and ultimately convulsive stabbing.

Probably it can be presumed that the scorpion's venom has small effect upon its own body or members of its own species as is the case with venomous snakes.—Ed.

BOOKS *continued from page 119*

area that forces a different kind of appraisal. The distressing fact emerges that Mr. Sloane frequently hovers on the brink of scientific accuracy.



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The dangers of simplification of meteorology are thrust aside with several degrees of carelessness. Line drawings, sprinkled liberally, and in many cases effectively, throughout the book bring the reader tantalizingly close, but inaccurately so, to many of the fundamental causes and characteristics of meteorological phenomena.

Thus, distorted, glib, or dangerously superficial explanations are presented so as to create erroneous mental images of weather phenomena which include high and low pressure areas, stability and instability of the air, aurorae, and twinkling of stars as an indication of a particular type of weather. His airy explanation of how "polar air streams" have moved the frequency of hurricanes northward dismisses difficult and complex considerations with distressing and slightly inaccurate ease. Another example of misleading types of drawings is the author's cross-section diagrams of cold and warm fronts which curiously seem to show cold air coming down the right side of the page (normally considered the east in basic map illustrations). This is a kind of disrupting image if the reader seeks a proper mental orientation of the movements of air masses.

To read this book as a reflection of Eric Sloane's philosophy and a demonstration of an extraordinarily keen sense of perception of the relation of man to animals, earth, and sky is to thoroughly enjoy it. To present the book fundamentally as the work of a meteorologist and as a book of weather science interpretation (as part of the title and jacket suggests) is to invite a more critical evaluation. One wishes that a more disciplined attention were put to bear on those line drawings and portions of text which form a part of basic weather instruction.

FRANK FORRESTER

CELEBRATED AMERICAN CAVES

----- edited by Charles E. Mohr
and Howard N. Sloane

Rutgers Univ. Press, \$5.00
339 pp., 107 illus.

Celebrated American Caves introduces the reader to our most noted caves. The story includes their history, their unique features, physical difficulties one

encounters in exploring caves, unusual finds of animal life in them, archeological discoveries made in caves, legends about them, and the economic and other uses to which caves have been put.

Fifteen contributors, all members of the National Speleological Society, the sponsor of this book, have written about the caves they know about from long personal experience. The authors' knowledge of archeology and other branches of science ably fits them to describe the wonders of these caves. Each man is an expert in his own field.

The quest for the unknown is what leads the true cave hunter into the darkness. The thrill of discovering blind fish, blind salamanders, cave crickets, scorpions, vampire bats, even cave-dwelling birds, new and beautiful rock formations, and gypsum cave flowers are all shared with the reader. One explorer came upon a unique fish that lives only in a 93° F. spring in a cave in Nevada.

The experience of descending into the Devil's Hole in Texas, over 400 feet in depth; the tragic story of Floyd Collins; the story of bats trained for carrying incendiary bombs; important archeological finds, such as "Lost John", the prehistoric Indian gypsum miner found in Mammoth Cave; the wanderings of the "Leather Man" in New York and Connecticut; and many others are yours if you read this most interesting book.

DAVID M. SEAMAN

TRAVELS AND TRADITIONS OF WATERFOWL

--- by H. Albert Hochbaum

University of Minnesota Press, \$5.00
301 pp.

THE vast numbers of ducks and geese that once nested and flourished on the Great Plains of North America have been sadly decimated by drought, drainage, and overshooting. Alarmed by this decrease, Mr. James Ford Bell of Minneapolis founded the Delta Waterfowl Research Station, with headquarters in the vast marshes south of Lake Manitoba. Scientists and conservationists have visited this research station in increasing numbers and have added much to our knowledge of the habits and requirements of these valuable birds. The most distinguished of their contributions is a book, *The Canvasbacks of a Prairie Marsh*, written and illustrated by H. Al-

bert Hochbaum, the Director of the Delta Laboratory, which won the coveted Brewster Award of the American Ornithologists' Union. Now, after a further decade of intensive observation, Dr. Hochbaum has published another volume on waterfowl, one which, as Professor Rowan says in the introduction, will detract nothing from the author's "enviable reputation as observer, recorder, and artist."

Southbound flocks of clangorous geese, flying in formation, have long been symbols of bird migration. It is this problem of migration, of homing ability and orientation, to which Hochbaum addresses himself in this book. The early wanderings of young ducks as they follow their mother about the marsh, their later random flights to other marshes north, east, south, and west, and finally

the undeviating annual migrations to and from the south, are shown to be successive steps in gaining familiarity with the environment. Although the migratory impulse itself and some of the means of orientation may be innate and unlearned, Hochbaum believes that the migrations of waterfowl are molded to a great extent by learning and tradition. Better to interpret his own observations, Hochbaum includes a discussion of all recent work on homing and orientation in birds.

Travels and Traditions of Waterfowl is a well-documented contribution to science. But many who are not scientists will prize this book for its wealth of sympathetic lore about the waterfowl of our prairie marshes.

D. AMADON



STONE AGE ARTISTS OF MILINGIMBI continued from page 127

graduated tube about five feet long and three inches in diameter at the bottom. Baralji, a fine-looking young man who served as interpreter, was choreographer. He designed many of the dances, the effigies of sand, and the music, which were all part of the event. When King George VI died, the corroboree went on every night while the dead monarch lay in state in far-off Westminster Abbey.

We asked if we might attend one of the sessions. Baralji called for us by lamplight, and we saw that his initiation welts gleamed on breast and shoulders. We followed him with flashlights down the broad shell path.

The camp was completely dark except for a smoky lantern set on the ground, which lighted our faces and the whites of the "orchestra's" eyes. Vague rustlings indicated watchers in the shadows. We sat on a log, Baralji on a gasoline tin. Laughter sprang from the darkness every now and then, where men, women, and children were lounging.

From somewhere behind him, Nmuramura produced a *didjeridu*. He played a few bars on it, a droning vibrant sound, punctuated with a strong beat.

At first, all the music seemed much alike. But when I began to search for the beat and to mark it out in the dust, it proved remark-

ably varied. This *didjeridu* had a decidedly sonorous boom.

"May I try it?"

Nmuramura passed me the hollow tube. It was surprisingly heavy, made of smokewood smoothed on the outside by the touch of many hands. I tried blowing into it but made ludicrous sounds. The black men didn't conceal their amusement, and I could imagine their "take-off" of my attempt would be low comedy. Actually, you don't blow into it, Baralji explained. You "pull wind." This was easier said than understood—or accomplished.

Baralji then brought out his own *didjeridu*, one decorated with ritualistic designs intended to make it a more effective instrument. He squirted a mouthful of water down inside to give it better tone, then began to play. It was incredible how long the sound went on without his gasping for breath or stopping to wipe the mouthpiece.

The other men beat time, one with a hammer handle, the other with a tobacco tin against the log. The women in the shadows clapped rhythmically, their cupped hands smacking skinny thighs. Anything would do, but not to beat time would be unthinkable.

The "song man" announced the numbers, with suggestions from the shadows. He would hum over the melody abstractly at first, then start in. Usually it was a song with an

Indonesian air plus some yelling.

Baralji held up the *didjeridu* for a time, then rested the end on the ground. When he wearied of his perch, he slid onto the ground without losing a beat . . . then rested the instrument in the fork of his toes . . . then crossed his ankles.

"How many more rounds you want?" he inquired pleasantly.

"Just one more," said my husband.

They did two more songs. The last was the result of good-natured banter from the unseen audience—a ditty about a mosquito attacking a man and telling how the latter took vengeance. It was evidently hilarious.

A few weeks at the mission, and some study in its excellent library, gave us some knowledge of the Yulnu. But there are infinite gradations of behavior, varying from place to place and from tribe to tribe, which we could never learn because of language barriers.

Those Aborigines who live around the missions are not far removed from their ancient mode of life, though they long for the bright lights of Darwin. They appreciate medical aid, and their children attend schools more and more. Many of the old customs are gone forever, but the best are retained. Tribal control is the Aboriginal's best protection during his present evolutionary period.

By midmorning of the next day, however, they are out again on the surface, as lively as ever. What brings them up? No one seems to have the answer. I believe that light is a factor.

I suspect that snow fleas adjust their metabolism as do many other animals that live in comparatively cold places. Such animals are much more active at low temperatures than their relatives living in warmer places. Snow fleas remain active even at the freezing point, a feat many of their close relations cannot accomplish. Even on their icy home, they are very active little creatures.

The food of the snow flea poses a problem not so difficult to solve. A vegetarian so small must live on what is available, and only a limited diet can be found on the snow. Almost all of it is brought by wind. Evergreens are the dominant trees near glaciers, and all of them shed wind-blown pollen in great quantities in the warm months. This pollen is very common on the snow, and though it is resistant stuff, the snow flea is able to digest it. The little insect does this even without the aid of chewing, for snow fleas, like all springtails, possess only rudimentary mouthparts.

A less resistant item of diet might

be the various one-celled algae that live on snow surfaces. One kind, *Chlamydomonas*, becomes so plentiful by late summer that it turns large patches of snow a distinct reddish tint and is responsible for the "red snow" that may be seen on glaciers especially during the late summer months.

Where Do They Winter?

The most frustrating question concerning snow fleas is what becomes of them in winter. Certainly they are not able to remain active when the temperature drops far below the freezing point. They must winter over in a dormant state, probably as a resistant egg. This process is by no means unknown among insects and is called diapause. But where and how could they do this?

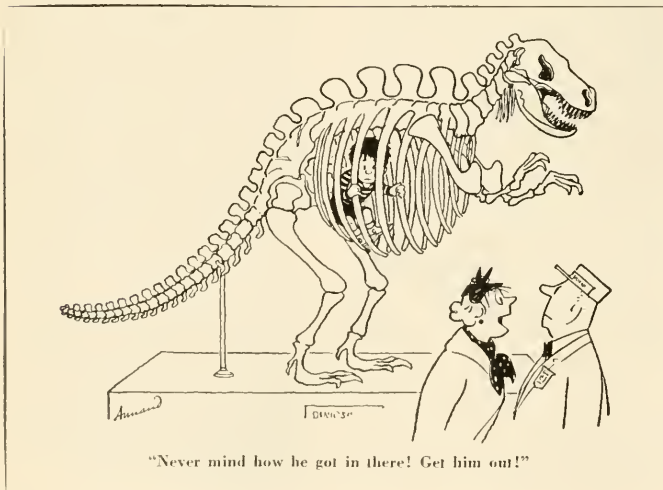
If the eggs of the snow fleas were to remain in mid-glacier through the winter, the creatures would have a minimum of ten or twelve feet of snow and ice to crawl up through when warm weather arrived in late spring. This would seem to be a hopeless task. Furthermore, how would they be notified of the arrival of spring under ten or twelve feet of snow? It is a possibility that trickling water, etching

paths down through the snow as it melts, might wake up the dormant eggs or young. Nevertheless, we must regard it as unlikely that the snow fleas pass the winter in mid-glacier.

The only other possibility of winter quarters is among the rocks at the glacier's edge. We have already seen, however, that the snow flea we have been studying lives primarily in mid-glacier. I was not on the Lemon Creek Glacier late enough in the summer to see whether the snow fleas migrated to the rocks at season's end, but I doubt that this occurs. How could these almost sightless little insects find the rim of a glacier anyway? The rim is higher than the center. By crawling and hopping continually uphill, some of them might find it. But we must remember that a glacier is far from smooth and that uphill to a snow flea is merely over the next snow crystal.

So I come to the last suggestion, though with no assurance whatever that it is correct. I suspect that those snow fleas that are near the rim of the glacier at the end of the season do manage to take shelter and lay cold-resistant eggs in the rocks or shallow snow. Then these prospective parents and all other snow fleas die. In the next warm weather, their eggs hatch, and the snow is again repopulated from the rim of the glacier inward toward the center regions.

Like all other arguments, this one has a serious fault. In 1954, our team arrived on the glacier very early in June, and there were already hordes of snow fleas to greet us. Further, they were in mid-glacier, and this was before the melt season had begun or the snowfall had ceased. Perhaps the snow fleas do spend a cold winter in mid-glacier. Perhaps the young can know when spring is imminent and make their way up through the snow to the sun at the surface. I wouldn't be surprised at anything this amazing little insect might undertake.



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By NORMAN D. FORD

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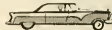
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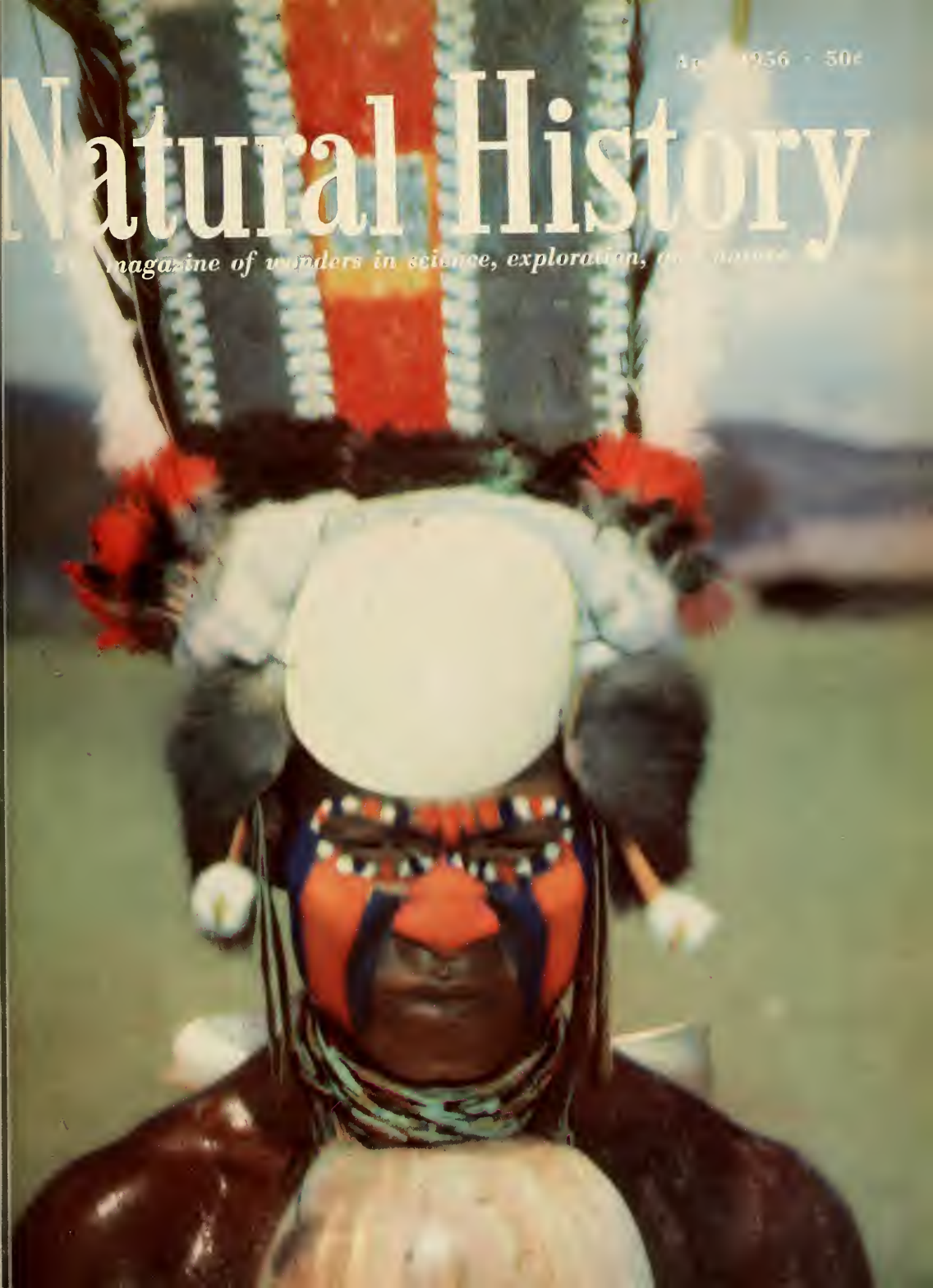
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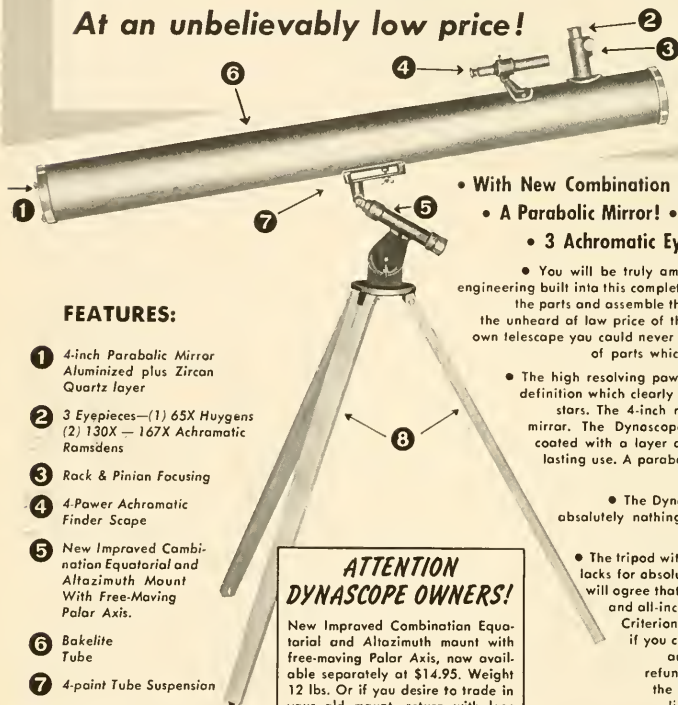
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April, 1956 Volume LXV, No. 4

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THE COVER THIS MONTH

The crowning glory of the Mbowamb of New Guinea is his headdress, which is used for all ceremonial occasions. This native dancer wears a "feather inlay" or mosaic headdress. Bits of feathers are fastened in a foundation of latticed bamboo and pandanus leaves, to form various patterns and designs. The border at the sides consists of the long black tail feathers of the Bird of Paradise, and the crown is made of two Duke of Saxony birds—skin, feathers, and all.

The custom of loaning headdresses is widespread, the owner receiving a large piece of pork in payment. The poorer man will make decorations for himself out of chicken feathers and other readily available material. Among the Mbowamb, wealth and dress go hand in hand.

The Mbowamb paint their faces only for high festivals. The designs have no significance; each native paints according to his preference.

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FOLLOW THE WHALE

----- by Ivan T. Sanderson

Little, Brown and Co., \$6.00
423 pp., 11 maps, 14 pp. of illus.

WHALES have figured largely in the lives of seafaring men since the dawn of civilization. In *Follow the Whale*, Ivan Sanderson has re-enacted the whole fabulous story of man's chequered career in quest of the giants of the sea, with emphasis on the whale rather than on man. He has an interesting technique in presenting his facts that stimulates the imagination of the reader.

Ivan Sanderson has firsthand information on this subject from his own personal experiences and a basic understanding of the greatest creatures that ever lived. He draws on the wealth of knowledge found in the fat volumes and historical and scientific publications and from effects available in the many whaling museums and libraries. His researches carried him into such remote fields as Cro-Magnon cave painting, the ashes left by prehistoric man, and hieroglyphics inscribed on stone by the ancient Egyptians. Furthermore, he has not entirely ignored the information that could be drawn from native folklore, tradition, and superstition.

Ivan Sanderson shows how long before recorded time maritime peoples, with their puny weapons and flimsy boats, matched their skill and courage against a hundred tons of threatening annihilation. In narratives no less thrilling, he traces the dramatic course of whaling through its various phases—from Neolithic man to the Phoenicians, the Basques, the Japanese, the Norsemen, the American Indians, and finally to the modern floating whale factory of today.

Much has been written about whales, but they are still among the strange and mysterious creatures about which we know so little. Only recently was it learned that a school of whales may be quite communicative, uttering sounds pitched in a key inaudible to the human ear. Their recorded sounds have been likened to a crowd of children coming out of school.

Follow the Whale is fascinating and should be of real interest to the general reader and more especially to the historian, naturalist, and those interested in the sea.

Ivan Sanderson is a graduate of Eton

and Cambridge, a well-known lecturer, explorer, author, and collector of wild animals, and a familiar personality on radio and television. Mr. Sanderson has led numerous expeditions to remote parts of the earth. He made his first trip around the world at the age of seventeen, spending several months in Indonesia collecting biological specimens for the British Museum of Natural History.

GEORGE G. GOODWIN

THE NYLON SAFARI

----- by Rehna Cloete

Houghton Mifflin Co., \$3.50
276 pp., numerous illus.

THIS is not just another story about a carefully planned hunting trip to the Dark Continent. It is something delightfully and pleasingly different. The Nylon Safari, as the name implies, is a feminine conception, embellished by a woman's imagination of a safari that she doubtfully accepted, in the first place, as a desirable way to celebrate an anniversary.

The principal characters of this book are, of course, Rehna Cloete or "Tiny"; "Call me Bill," the white hunter, a parody of all white hunters rolled into one; and her husband Stuart, who dragged Tiny from the comforts of a modern, luxury hotel into the wilds, to satisfy a long-coveted dream.

For three weeks Tiny accompanied her husband, the white hunter, and the laughing, good-natured safari boys on a camera trip through mud and drought in Tanganyika. They followed a route, stopped at resthouses, hotels, and camped in places that I know well. The exciting experiences described by Tiny, so charmingly detailed and unvarnished, give a very realistic conception of the daily routine on a safari. The day began in the bitter cold hours of the morning, five o'clock, and often ended after dark at night, sometimes with the car hopelessly bogged down in a mudhole, much to the amusement of the safari boys who always burst into great peals of laughter.

Eventually Tiny and her companions made their contacts with the great creatures of the African veldt, elephant, rhinoceros, lion, and many others. They also saw the countless herds of game on the plains. But it is the means by which she

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obtained her objective, told with rare humor, that makes this story different and so fascinating to read.

There were the dark moments when fear, discomfort, and multitudes of mosquitoes made life miserable, but eventually Tiny came to know herself, took everything in her stride, and ends up telling her readers that there could be

no more exciting and no more wonderful safari than hers—now that it is over!

GEORGE C. GOODWIN

THE GOLDEN EAGLE: King of Birds

----- by Seton Gordon

Citadel Press, \$5.00

246 pp., 17 photos, 1 map

IT is quickly apparent from a reading of this work that anyone interested in birds has missed a great deal if he hasn't observed the Golden Eagle at close quarters. And not many people have because of the remoteness and relative inaccessibility of its eyries. But this book is much more than an account of the pleasures of eagle watching in the rugged and beautiful highlands of central Scotland and on the Isle of Skye; it is the document of a glorious, harassed, controversial, and often savagely treated creature as seen through the eyes of a perceptive naturalist who for half a century has lived among eagles.

The narrative recounts the history of Golden Eagles in England and their distribution throughout the northern regions of the world. Details are given of their use in falconry, their marvelous flight, their food, and their enemies, of which man alone threatens their existence. Gordon has screened the literature and blended it with his own rich knowledge. Some eagles, he says, live to 93 years of age; the incubation period is given as 43-44 days; the maximum weight is about 13 pounds; and there is no evidence that the Golden Eagle can lift more than its own weight. He gives records of eagles killing wildcats, adders, rattlesnakes, lambs, and even deer, but their main staple of food is rabbits and hares—and they thus are valuable to man. The author paints an audacious, aloof, and noble bird against a background of its affectionate care for its young, with the couples often remaining paired for years and perhaps for life.

Inevitably the author must tell the sorry tales of a few "Hawk Mountains" in our own Southwest. One shocking story is of the killing of 8300 Golden Eagles by a single aviator in a light plane. It is a testament to Gordon that, with all of his love for this great bird, he presents an unbiased, unemotional report. He correlates the killings with similar occurrences in England many years ago. He reveals important facts and not a little false mythology concerning the ancient animosity between the sheepman and the Golden Eagle. One result is that in Europe mere handfuls of eagles remain. For example, only 40 to 50 pairs remain in Switzerland and only 50 to 60 in Sweden, and they no longer breed in many countries which belatedly have offered them full protection.

The conservationist and the bird watcher will find provocative material in this book. By studying it they will be better able to evaluate the problems of the rancher. There is more to these problems in America than the mere squandering of great riches in Golden Eagles along the lines of the Passenger Pigeon, the Buffalo, the Heath Hen, the Eskimo Carlew, and so many of the wonderful animals which formerly constituted our wildlife bank. Perhaps this report will help us to see the problem for what it really is and to deal fairly with it; else we will have the familiar situation of a succeeding generation leaping to "save" a great bird when only a fragment of the population remains.

My only criticism of Seton Gordon's report is that, while he mentions a remarkable solution to the problem of the predations of the Golden Eagle, I feel he does not make as much of it as he should. The Swiss, in the Canton of Bern, have devised a system which guarantees the protection of the Golden Eagle and is equitable to the sheepmen; namely, when predations occur they are reported to a warden, and, if confirmed, the State pays for the loss. The Swiss method might work in America and might not prove more costly than the more orthodox game controls. At least the matter of population control would be in official hands. Thus we might avoid much of the wholesale decimation of a bird that has many friends in America — although none seems to be as articulate as Mr. Gordon.

E. THOMAS GILLIARD

AYORAMA

--- by Raymond de Cocola and

Paul King

Oxford University Press, \$4.50

316 pp., 6 drawings, end paper maps

FATHER DE COCCOLA, a native Corsican, came to the Central Arctic as an Oblate missionary in 1937 after an education in France. For twelve years he lived among those Eskimos who inhabit both sides of Coronation Gulf and the Queen Maud Sea. His principal missions were at Cambridge Bay on Victoria Island and Burnside Harbour on Bathurst Inlet, but apparently he spent very little time at either place. Instead he lived almost constantly with the natives—sealing, fishing, hunting caribou and bear, making long winter sledge trips with them.

This is the story of his experiences as translated by his collaborator, Paul King, a British Columbian newspaperman. Although told in narrative form, some liberties have admittedly been taken with time, place, and persons in order to facilitate the even flow of the story. This

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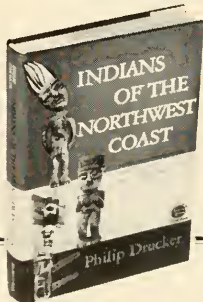
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INDIANS OF THE NORTHWEST COAST

By PHILIP DRUCKER

Bureau of American Ethnology,
Smithsonian Institution

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NATURAL HISTORY BY

McGRAW-HILL

perhaps explains how such a wealth of Eskimo customs could be attributed to the lives of such a few families.

The theme of the book is pretty well summed up in the native term *Ayorama*, which the author translates "Because I am helpless." It might be more freely translated as "Life is like that," a term used frequently whenever an Eskimo resignedly accepts the buffets of his harsh environment.

The story that de Coccola tells is not a pretty one. It begins with the birth of a baby in a snow hut and ends with the stench of decomposing bodies following a pestilence; nor has the author dealt any less realistically with the other facts of Eskimo life as he saw them. In his eyes Eskimo life is a grim and unending battle against cold and hunger. But there is much of beauty in the book also—both the beauty of the country and the beauty of the Eskimo spirit. Beautiful also are the translations of the many Eskimo songs.

Father de Coccola tells very little of his mission labors. One almost wonders if the Eskimos did not effect as much of a conversion on the father as he did upon them. One feels sure that they liked and respected him and he them.

The book ends with a glossary of the Eskimo terms used. In addition, it is illustrated with lively pen-and-ink drawings by James Houston, himself a traveler among "the People Beyond."

ROBERT McKENNA

ME PAPOOSE SITTER

----- by Gordon Langley Hall

Thomas Y. Crowell Company, \$3.50
243 pp.

THE "papooses" for whom Mr. Hall was sitter were offspring of the Ojibway Indians who live at Gull Bay on Lake Nipigon in northern Ontario. When, at the age of nineteen, the author forsook his native England to become for a year a reservation school teacher in the frozen north, little did he realize that he was also assuming the roles of baby-sitter, midwife, doctor, counselor, and social arbiter in this eccentric Canadian Indian community.

Actually the Gull Bay Ojibways have lost so much of their native culture that they can scarcely be considered "Indians." They trap, fish, wear moccasins, and speak their native tongue, but here all resemblance to Indians as we think of them ceases. They are as much at home in bush planes as on dog sleds. They read movie magazines and comic books, and listen to news of the outside world on battery-operated radio sets. On the other hand, their version of Western culture is bizarre, to say the least. Red nail polish is in

vogue for both sexes. The pupils in Mr. Hall's schoolroom constantly chewed snuff, and were supplied with spit cans as a necessary convenience. At a dance given to honor the author's mother's fortieth birthday, the Ojibways concocted a punch of mixed canned fruit and vegetable juices garnished with prunes, asparagus tips, and sardines.

More than anything else the happy-go-lucky inhabitants of Gull Bay resemble characters out of a Steinbeck novel, and the author describes them sympathetically and with affection. For the reader who is interested in the traditional customs of the Canadian Ojibways, this is definitely not the book. But although it is obviously embroidered and rather ineptly written, it is a humorous account of present-day Indian life in interior Canada.

HARRY TSCHOPIK, JR.

THE FUR HUNTERS OF THE FAR WEST

----- by Alexander Ross

Ed. by Kenneth A. Spaulding

University of Oklahoma Press, \$5.00
304 pp., 19 illus., 1 map

IN 1810, a young Scotsman named Alexander Ross enrolled in John Jacob Astor's Pacific Fur Company and sailed around the Horn to Fort Astoria, the great fur-trading depot at the mouth of the Columbia River. In 1825, he resigned from the Hudson's Bay Company, the British firm that succeeded Astor's enterprise. These two dates bracket the Far Western fur trade from its active beginning to its initial decline, and Ross' account of this dramatic era is one of the most complete and detailed that has come down to us.

During the brief span of fifteen years, a handful of mountain men pushed their way from the Pacific, through Oregon Territory, and across the Cascade Mountains and the Rockies to the Continental Divide. The quest for beavers led to the exploration of the Pacific Northwest, and most of the information necessary for the ultimate occupation of this region by settlers was obtained by these men who explored America from the west.

The chief theme of the book is the competition between British and American interests for the vast wealth in furs, and of the ultimate triumph of free trade over corporate enterprise. The characters are a cross section of the northwest frontier — traditional-minded company managers and adventurous, adaptable mountain men, Indian trappers and warriors, and tight-fisted Scotch traders. Indian encampments, trading posts, and frontier forts are described in detail and illustrated by the roughly contemporary paintings and drawings of Alfred Jacob Miller and Henry James Warre.

continued on page 222

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▲ THE MANY BAMBOO STICKS hanging down his chest indicate that this chief has held many Mokas, or giving festivals. He is wearing the Moka shell, which is a mother-of-pearl or gold-lipped shell of great value among these people.



▼ THE MBOWAMB NATIVES held the ceremony described in this article at Ogelbeng.



◀ THEIR HOUSES are built of a framework of timber covered with kunai grass. Owing to the cold climate, they are more comfortable when heated with a small fire.

New Guinea Chiefs

Give to Get Rich

Pecuniary ostentation reaches such a point in this inland tribe that everyone is almost constantly in debt, and no social prestige equals that of exhausting one's resources in an orgy of generosity

By ARNOLD MAAHS*

Photographs by the author

OF all the ceremonies of the southwest Pacific, the Moka Celebration (also referred to as Moga) of the Mbowamb natives at Mt. Hagen, in the interior of New Guinea, is the most incomprehensible to the modern mind. What could be more foreign to our economic philosophy than the belief that wealth does not depend upon having but on giving away?

About the only time when our social system approaches the spirit

of the Moka is when everyone in the community is in debt, even the richest man. In New Guinea, the biggest chief will complain, almost weeping, "I'm a poor man. I have nothing left." He will go out begging from those who owe him, and along the way, he will be besieged by his creditors, begging from him. Yet it is most important for a man in this tribe to be able to receive from or give to a Moka.

To belong to the Moka commu-

nity puts him in the upper class of the Mbowamb society. To understand this, you must realize that these people consider that things become of value only as they circulate among a wide number of people. An article thus has value only as it is traded. It is therefore through this formalized trading or exchanging that any native achieves the reputation of being a rich man. In this sense, the Moka is for the benefit of the individual. But it also

Guinea to raise \$750,000 to rebuild the missions of the American Lutheran Church in New Guinea. He has since traveled in many countries around the world making motion pictures, one of which was produced by Twentieth Cen-

tury Fox Film Corp. under the title "The Word." His wife has accompanied him in these travels, and they live with their two youngsters on a "broken-down" farm in Tilleda, Wisconsin, beside a fine trout stream.—ED.

*ARNOLD MAAHS is currently working for a Ph.D. in anthropology. He joined the U. S. Air Force prior to Pearl Harbor and served five years, gaining the rank of Lieutenant Colonel. He subsequently used motion pictures he filmed in New



▲ FULLY DRESSED FOR THE SING-SING, this woman now wears a bird-of-paradise plume in her headdress. Small cowrie shells (*tambu*) adorn her forehead, and a large Bailer shell hangs at her chest. Bracelets on her wrists are made from the anuses of pigs.

helps to lift others out of economic difficulties.

Because of the amount of property involved in a Moka, considerable preparation is necessary. And the arithmetic is so complicated that it would seem that only a mathematical genius could follow it. Remember, the Mbowamb native cannot read or write; he owns no adding machine and has never heard of a bookkeeping system. Now, imagine him entering into no less than eighty transactions, each of which involves either eight, ten, or more pearl shells. In addition, an indefinite number of other shells change ownership, as well as stone axes and other things of value. Further, pigs are put up "as security," and their individual sizes must all be remembered. For when a man gives his property away in the Moka, he wants to be sure he will get it back again.

Wealth in Bankruptcy

Not every loan can be called a Moka but only when it concerns eight, ten, or sixteen gold-lipped, mother-of-pearl shells, which are loaned at the public ceremony. Over against these shells, the one who receives them has to put up a number of pigs. The pigs will be returned in an equivalent number when the Moka is paid back. The articles involved can be loaned to other men, but they always travel in a definite circle of friends. This leaves the native struggling and slaving to pay back, and the wealthiest man may be "bankrupt."

But nothing can take the place of the prestige that comes from holding a Moka ceremony.

This was the operation that I traveled to the community of Murip to observe and photograph. I had asked my good friend Rev. Felix Doering of the Lutheran Mission at Ogelbeng to keep me informed. When he radioed that a Moka was to be held about ten miles from his station, I flew from Madang and landed on the airstrip in front of his house. From there I rode a bicycle along a very slippery road of red clay to Murip, a collection of native

huts. The festival was to begin there the day of my arrival.

Murip was the home of a native mission teacher named Ogla, who was my host. He and a man named Pok of Ogelbeng were to be my interpreters and guides.

On my bicycle I had outdistanced my carriers, so I sat down to wait on the veranda of the native house Ogla had provided for me. Murip is higher than Ogelbeng, and I soon wished I had brought more blankets.

When my carriers arrived, I made some tea and had something to eat. Upon finishing, I found Pok and Ogla sitting on the grass with several other natives engaged in "drinking" sugar cane. The term "drinking" is the one the natives use in describing the tearing, sucking, and chewing necessary to extract the last bit of juice from the cane. The guests were smacking their lips as loudly as possible—a gesture of politeness indicating their enjoyment and high opinion of the quality of the sugar cane.

Pok found the hospitality of Murip much to his liking and suggested that we wait until we heard the sound of drums before going to the dancing grounds. But I vetoed his suggestion, and, as the supply of sugar cane was exhausted, we set out.

As we turned off the main track to go to the dancing ground, we met the first dancers, three young women who willingly put on a dance for my benefit.

The dress and decorations of these three and of the other dancers were the most elaborate I had seen anywhere in New Guinea. They represented far too much wealth for one person actually to have, but plumes, feathers, and shells are borrowed for the occasion from friends and relatives. Usually a piece of pork is given for the use of the decorations, and the borrower returns the favor at some future date.

The women's headdresses contained bird-of-paradise plumes; and small cowrie shells called *tambu* formed a band at the forehead. A fur cap or strips of fur had been put in place either above or behind the



▲ TWO MBOWAMB WOMEN wearing Moka shells on their chests. Their faces are covered with red paint.

▼ GREAT NUMBERS OF PIGS are used in the Moka ceremony. Several thousand persons congregated to enjoy it, many walking far to attend.





▲ WOMEN DANCERS marching in full dress. Most wear huge Bailer shells on the breast.



tambu shells. I counted as many as fourteen Green Snail shells hanging from the headdress at the back of the neck. Possum tails were fastened at the neck or hung below the waist. Mother-of-pearl and Bailer shells were worn on the back and also on the chest. Both native and European beads were worn around the neck. A liberal application of pig grease had been smeared over the entire body, and the faces were all painted.

The dance was a sliding of the knees in a sideways motion so that the long scarves that hung from the women's waists, front and back, swirled and swished. The dancers stood in line and sang and swayed

before one group of spectators and then turned to face another.

With Pok as my guide, I walked along a native path that took us to where a great number of pigs were being staked for trading. Farther on, at the end of the dancing ground, the men's house was crowded with perhaps half a hundred natives packed in like sardines. They obligingly moved aside and made room for me and even found a piece of wood for me to sit on.

I found myself surrounded by several *Wue Nuims*, the wealthiest and most important men of the tribe. At my right sat the "Papa of All the Pigs"—the richest and biggest man

involved in the Moka, whose duty and privilege it was to boss the proceedings. His pigs were to be brought in first; then those of the Number Two man, and so on down the line. I counted a total of 103 pigs.

Through Pok, I was able to converse with the *Wue Nuims*, or Big Chiefs. In the company of these great men, natives of lesser degree had not the temerity to speak.

Upon inquiry, I found that the Papa of All the Pigs had ten wives. It was popular to have many wives, because many pigs could not be raised without many wives. This combination, the "Papa" stated, was "good fashion."

At my left sat an even bigger Chief — indeed, the Chief of all Chiefs and the biggest man among the Mbowambs. His name was Raglpa. In addition to his wealth, he was also one of the many fathers-in-law of the Papa of All the Pigs. Both were about the same age, and Raglpa had once had ten wives, too. However, two of them had died and two had run away. Two more were now old and were living with their children. This had reduced his harem to a mere four wives. He said he had eighteen children, eight girls and ten boys.

▼ THE FACE PAINT is applied with very great care while watching in a mirror. Not many years ago, this would have been impossible.





it was very important that the donor remember the sizes of the pigs.

A group of women were dancing and singing in the rain, telling in plaintive tones how hard they had worked raising the pigs that were now being distributed. They felt sorry for the pigs, which were going to strange owners.

I had gone back into the house because of the rain, and a number of women, whose skins were covered with grease, crowded in with us.

The lard on their bodies was rancid, and the odor of some fifty natives jammed into the house was suffocating. The dancers outside put on their rain capes (*karukas*) made of pandanus leaves sewed together, and continued their song and dance.

The rain kept falling, and I wanted to get back to my house at Murip, but I had forgotten my raincoat and plastic coverings. I was afraid my cameras would get wet in their canvas bags; but when I

◀ AFTER elaborate dancing, the day arrived for cutting and eating the meat.

▼ ONE of the dancers takes time out to devour a chunk of suckling pig.



Raglpa now turned to me and said, "How many wives do you have?"

I replied that I had only one.

"What's the matter with you?" he asked.

Paying Off with Pigs

The Big Chiefs are not possessed of an inferiority complex, nor are they inclined to be shrinking violets. They never lose an opportunity to tell people what great men they are. And with only one wife—well, there was just something wrong.

The Papa of the Pigs now said that he wanted to wait until morning to tie up the animals to the Moka pegs. But those who were to receive them couldn't control their eagerness. They said they had waited so long that they simply couldn't wait anymore. So, even though it was still raining, the pigs were led in and fastened to the stakes. Then they were counted, appraised, admired, distributed, and led away by their new owners.

One man got eighteen, which he promptly distributed to the small men who had helped him in the past. It was paying his debt. His wives led some away, of course. But it was mostly a matter of pigs merely changing hands. At some time in the future when the Moka was repaid, the pigs in equivalent sizes would have to be returned. For this reason,



asked the natives if I could borrow two *karukas* for the trip to Murip, there was no response.

After much discussion, I was told that all the people also wanted to keep dry. My interpreter then went out to see if he could solve the problem, and after some time he came back with Raglpa, the biggest Chief in the tribe.

The old Chief had one *karuka* in his hand, which he presented to me. Then followed a conversation typical of the Mbowamb people. He said, "You and I are the same kind of men, for we have both come long distances."

I nodded my head, and the Chief continued: "This is not my place, and it isn't your place either. We are both strangers here."

To this I agreed, and he continued, "The people here won't give you a rain cape. They don't feel sorry for you. No one will give you a *karuka*."

As this was quite obvious, I nodded my head.

"Yes," the Chief continued, "no one will feel sorry for you here. But I feel sorry for you. Therefore, I give you my *karuka*, as I am a very good friend of yours."

This was my cue to tell the Chief that he was a big man, a generous man, a rich man with many pigs and shells. As there is little modesty among primitives, he admitted it all.

"Yes, we are both big men," the Chief said. "In your country, you are a big man, and so am I in mine."

I thought the matter closed and decided that the Chief would never get to Wisconsin anyway; so I said, "Yes, in my country I am a big man."

The Chief nodded. "Now tomorrow, when you return the *karuka*, bring me a present of a gold-lipped shell for it."

What a salesman the Chief would have made! He deliberately built me up. He didn't want much for the loan of a rain cape! (A gold-lipped shell is equivalent to the price of a big pig.) Even in the United States, a big pig would be very good rental for the loan of an umbrella on a rainy night!

Pointing to the long line of bam-

boo sticks on his chest, I said, "You are a rich man. You have made many Mokas. You have the wives and the shells and the pigs. I am only a rub-bish man. I am so poor I don't even own a raincoat."

Raglpa laughed, and the men in the house roared. He had known all along that his request for a gold-lipped shell was ridiculous, but he thought he'd try it anyway. Later I gave the old man a couple of razor blades, which made him very happy.

A little later, the "Papa" of the Moka came and said that he had decided to delay the killing of the pigs until Monday. The natives would then eat the pork on Tuesday and exchange the shells and end the Moka on Wednesday. This meant I would have three idle days.

I said, "It looks as though I'll be ready to die by the time you get to the last big sing-sing."

He said, "Are you going to age so rapidly in a few days?"

I told him that I was impatient.

He laughed. "All right then. Tomorrow we'll show the shells and so on, in order to have the sing-sing on Monday."

This was excellent for me, so I told him it was "good fella."

An Angry Native

While we were talking, one of the men picked a large leaf from one of the bushes, and this so angered the native who had planted it that he wanted to beat the vandal. While he was searching for a club, the man ran for his life. Several of the friends of the outraged man joined in pursuit, one of them carrying a bow and arrows. But the offender lost himself in the maze of trails. It was an instance of how easily anger is aroused in these people.

The conversation then turned to a recent murder a day's walk from Ogelbeng. Four men had been involved in it. One had gone to the victim and invited him to come to his house for the killing of a pig. Completely unsuspecting, the man went along. En route they met the other three men, who fell on the victim and strangled him.

It is almost impossible to hide



▲ THE VALUABLE GOLD-LIPPED SHELLS were carefully laid on the ground more than 600 of them. The spectators derived much pleasure from beholding such opulence.

anything from a native community, but somehow these men were not seen. They were clever, too, in disposing of the body. They dug a hole in a stream bed, put the body in, and covered it with rocks. Then they arranged other stones so that sand would cover the body and the hole. It had all the earmarks of a perfect crime.

Then came the search for the missing man. Relatives and friends combed the countryside, searching all the thickets and swamps. They agreed that he must have been killed but were unable to find a trace.

But natives have an amazing memory for detail. One day, a man noticed a difference in the bed of the stream. Rocks were in a different place, and the water followed a different course. He investigated and found the body.

Then came the process of finding the guilty men. Natives usually know exactly where any person is at a given time. Ask for an individual, and you will be told he is at his house, in his garden, or gone visiting. The natives checked and double checked until they were able to piece together the crime, and the next morning a line of police boys went out to bring in the criminals.

It is impossible for a native to run away. Outside his own community, he is a stranger in a foreign land. No one will give him food or shelter.

The police were thus able to take the four men into custody. It was then discovered that the murderers had killed four other men, and the only reason they had done away with the last victim was because they suspected him of evil magic.

The house at Murip was on top of a mountain, and the wind had a clean sweep up the valley. Most

of the day, a cold driving rain fell in sheets. Inside the house it was almost as miserable as outside. Finally, I prevailed upon the natives to build a fireplace inside and start a blazing fire.

I was now living in a timeless world. There was no sun, and I had no watch. When I became hungry, I ate. When I got sleepy, I went to bed. The sun refused to shine even the third day, and I had been unable to take a single color picture.

Finally the sun shone, and I had

a field day. The dancing ground was so jammed with people that photography was a problem. Someone would walk in front of the camera just when I found a place.

The pork had already been roasted by hot stones placed in holes dug in the ground. Each hog had been cut into four pieces, and the dancing ground was now littered with pork.

The women began their dance first. As soon as two or three were decorated, they would begin to dance, displaying their elaborate costumes first in one direction and then another. These were young women and youngsters of six or seven.

The men's dance was more of a march, with three, four, or five abreast in a huge circle. At every step, they would stamp the ground as hard as possible. Their decorations were simpler and fewer than those of the women. But a head-dress of bird-of-paradise plumes was essential for each man.

Suddenly the men stopped dancing, and it was time to divide the pork. A piece of pork would be held up and the attention of everyone directed to it. It would then be presented to the recipient. No payment could be made more public or have more witnesses.

Then the payments for the decorations began. The idea was to put more meat on a man's shoulders than he could carry, so that everyone would be impressed by the donor's generosity. The givers shrewdly picked out an old man, however. They piled up such a load of pork on his shoulders that three men had to steady the load as he carried it away. Meanwhile, the donors called attention to their generosity through much yelling.

This was also a good time for big men to pay off debts at a cheap rate. At a previous Moka, some of the "small" men had helped the big Chief with a shell that was worth a pig. But it was now perfectly legitimate for the big man to pay for the shell with one leg of a pig. Thus, the Chief could pay for four shells with only one pig.

▼ EACH SHELL IS CAREFULLY POLISHED and rimmed with red clay. They can scarcely be treated too carefully. This chief has been the recipient, and it is possible that his sad face expresses the heavy responsibility he now carries until he can accumulate enough to become a sensational giver.



continued on page 223



▲ THE CATERPILLAR begins the spinning of its cocoon.

▼ FIFTEEN MINUTES LATER it has made a little progress.



▼ AFTER TWO DAYS, we find the beginning of a definite change.



Many have seen this butterfly (*Papilio machaon*), but few have aspired to take a set of photographs of it comparable to these by the celebrated European photographer, H. Eisenbeiss. The genus *Papilio*, as originally designated by Linnaeus, embraced all the butterflies, but it is now restricted to the typical swallow-tailed butterflies and some of their near allies. Several subspecies of *Papilio machaon* are known from the Northern Hemisphere, including North America.

From Caterpillar to Butterfly

A remarkable photo series showing the metamorphosis of a widely distributed butterfly of the Northern Hemisphere

By H. EISENBEISS

▼ THEN things move much more rapidly. These two stages were achieved within only two minutes.



◀ ON APRIL 28, six and a half months after the first picture was taken, the butterfly emerged.

▼ TEN MINUTES LATER, its wings had spread and hardened as shown here. The lowly caterpillar has become a resplendent creature of the air.



ANOTHER DAY is needed, however, for the caterpillar to finish encasing itself.



U.S. Coast Guard

▲ FRAMED in the plexiglas nose of an Ice Patrol plane, an observer scans the ocean for icebergs.

IT was April 14, 1912. A young man was pulled out of the North Atlantic into a crowded lifeboat. "I don't want to live," he sobbed. "My wife has just drowned!" An iceberg stood only 100 yards away, and as the young man stared at it, he shook his fist and screamed, "Murderer! Murderer! Murderer!"

Time marches on to late 1943, when a 12,000-barrel Dutch tanker lost its convoy in the fog of the North Atlantic, rammed an iceberg, and exploded. Only two badly burned men survived; the others were burned to death or drowned.

The plucky, tangy fishermen who work the Grand Banks of Newfoundland, pulling out cod and haddock for Boston, Bristol, and Bordeaux, know the inscrutable menace of the iceberg better than most. "*C'est diabolique!*" the French fishermen say with vast simplicity.

The iceberg gives a challenge that man hates: "Pass at your own risk!" It invades the busiest ocean turnpike in the world — the congested waters of the western North Atlantic. It is the largest moving thing in nature that man has not mastered.

Often camouflaged by fog or storm as it grinds through the night, the iceberg is an enemy whom all fear, a monster whose exposed part may be as large as a six-story building but with about eight times more of it underwater.

Visualize moving a mass bigger than a 6-story building 7 to 50 miles in a day, for that is how far the Gulf



▲ BEAUTIFUL IN BROAD DAYLIGHT but a horror in fog: one of the several hundred bergs that stream

Stream can move a Grand Banks berg. Lost bergs are terrible juggernauts in the expansive ocean. Untracked, they may be found again only when the lookout yells, "Iceberg dead ahead!" and the fragile

ship crunches into the granite-like ice.

Around the clock from February to July, planes patrol the Grand Banks, guarding a million lives plus ships and cargo worth \$10 billion.

he Bergs

The International Ice Patrol has made the sea lanes safe; now scientists are weighing the practicality of towing large bergs to the rescue of drought-stricken areas

By JESSE C. BURT*



U. S. Coast Guard, from Gendreau

yn from western Greenland each season to men-
the North Atlantic's \$10 billion shipping route.

The instant there is trouble, a cutter is ready to streak to the site with whatever help it can give. This unique international crusade is more than heroic and romantic, it is a brilliant action in useful research.

The best way for you to sense the challenge of the iceberg is to make you an armchair observer on a documented Ice Patrol Operation. You are aboard a Coast Guard cutter. Night is coming; so is a storm. You



U. S. Coast Guard, from Gendreau

▲ THE COAST GUARD ICEBREAKER "Eastwind" on duty in a Navy Task Group in the arctic, followed by a plucky ocean-going tug. The "Eastwind's" helicopter took the picture.

are tracking three bergs. The storm, with its 50-mile-an-hour wind, lashes the rigging; and the foaming sea slashes over the cutter and hurls it about like a chip in the palm of a giant. "If we should strike one of those bergs . . .," you shudder. You brush the thought aside. The most skilled team of iceberg detectives in the world are on the job. Even through the storm, they keep track of the movement of the icy specters.

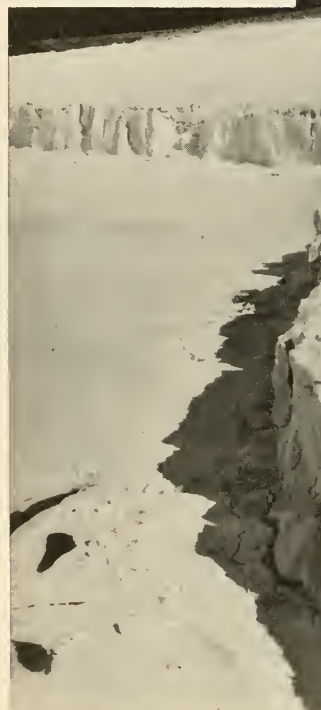
*JESSE C. BURT, who holds a Ph.D. in history, early became interested in the "Titanic" disaster. Later, as a Harvard student, his interest in icebergs was renewed by visits to the Widener Library, which was built to the memory of a member of the Widener family who was lost in the "Titanic." Word has just come that shortly after finishing this article for NATURAL HISTORY Magazine, Dr. Burt slipped on the ice and suffered an injury to his writing wrist. But he promises us another article soon.—Ed.



◀ THE ICECAP that covers almost all of Greenland creeps outward in all directions and discharges into the sea in "plastic rivers" of greater or lesser width.

▼ FIVE MILES OF THE FACE of Pettiwick Glacier in Greenland, photographed from a Coast Guard helicopter.

U. S. Coast Guard, from Gendreau



Finally dawn comes; the seas gradually begin to quiet. The iceberg detectives, without heroics, summarize their detailed observations on wind, temperature, sea, storm, and — their three bergs. A report crackles over the radio waves to the nerve center of the Ice Patrol, the town of Argentia, Newfoundland.

Then something happens quite unlike anything else in the world. All commercial broadcasting beamed to the Atlantic suddenly dries up so that the Coast Guard Radio Station NIK Argentia — the

radio voice of the Ice Patrol — can ride in loud and clear with its twice-daily bulletin. After a cordial good morning, the announcer gives the latest information on the bergs, including the three that had been lost, in a fifteen-words-a-minute message. The silence that is created for this voice from the Ice Patrol is proof of what the skippers think of icebergs.

NIK is like an oceanic party line. Ships share with the central office their own observations of sea, weather, and ice. An average of 302 ships provide information to NIK

free of charge each year. They represent 21 different nations.

International Co-operation

As evidence of the Ice Patrol's respect for the courtesy of the high seas, at the end of the ice season an individually written thank-you letter goes from the Command to the master of each co-operating ship.

Not long ago, at least as the historian measures time, information about the sea lanes was as jealously guarded as Fort Knox. Now, however, all ships have free use of Ice Patrol data. The secret of the suc-

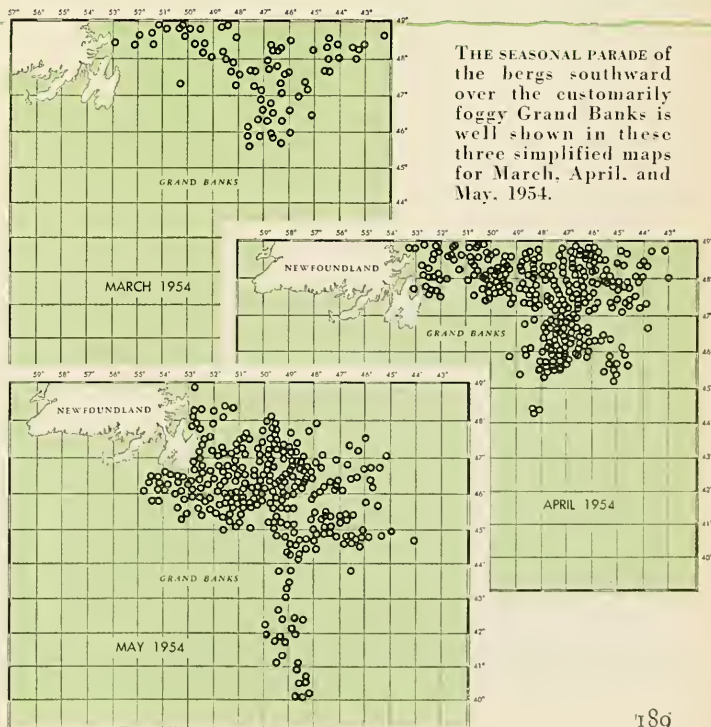


U. S. Coast Guard

▲ SEVEN-EIGHTHS HIDDEN: an air view giving some idea of the treacherous underwater portions that sea captains fear. The Coast Guardsmen who photographed this berg named it Paul Bunyon's Lower Plate.

✓ AT HEADQUARTERS of the International Ice Patrol at Argentia, Newfoundland, Lieut. Commander Armand J. Bush of the U. S. Coast Guard is plotting on the master chart the drift of bergs affecting the shipping lanes. Twice daily, all other radio transmission goes off the air so the information can be sent to ships in the area.

U. S. Coast Guard





U. S. Coast Guard, from Gendreau

▲ WAVE-CUT ARCHWAYS provide interesting photographic studies for cameramen in the Ice Patrol.

cess of the Ice Patrol has centered in its ability to pool and share the information. The reports of merchant vessels and of commercial and military aircraft are added to those of the patrol zone forces. Predictions of iceberg drift are worked out in a central clearing house, and these enable ships to adjust their courses.

Thus, a new kind of truth has been established. Until recently, the iceberg has embodied everything that is useless and worrisome—"all that discourages man," as one book published in the 1880's put it. But today we look upon the iceberg as having inspired useful research and led to international co-operation.

Every iceberg we see is a visiting card to remind us that our planet still contains six million square miles of ice. Most of the bergs of the North Atlantic come down the Labrador current from faraway fiords of northwestern Greenland. The icecap of Greenland covers almost 90 per cent of the largest island on earth, in some places to a thickness of well over a mile. Greenland's glaciers are the fastest moving in the world, some progressing at the rate of 50 feet a day. Pressure produces the paradox of ice that flows. The bergs calve away from the mother glacier at the water's edge.

The advance of the icy monsters into the Grand Banks area is a spec-

tacle to grip the mind of modern man just as it excited John Cabot in the fifteenth century. When you see a berg from the deck of a passenger liner, it may be three years old, but it will probably last only twelve days if it is getting close to the Gulf Stream.

A North Atlantic berg may include five million tons of ice, and it is often sculptured into fantastic and awe-inspiring beauty. The annual parade may carry as many as 1200 bergs south of Newfoundland. The average, however, for the past 50 years is closer to 400 annually.

To imagine that an iceberg can be shattered by explosives is a dangerous myth, according to the Coast Guard. The only way bergs can be destroyed is by the old-fashioned melting process.

The Unsinkable Ship

In 20 years, from 1870 to 1890, 14 ships were sunk and 40 seriously damaged in iceberg collisions. The *Scientific American* in June, 1890, pointed out that the need was for a ship that would not sink, no matter how badly wounded. Years passed, and this solution was tested with the S. S. "Titanic," largest ship afloat, believed to be unsinkable. On her maiden voyage, her hull was torn open by a smallish berg, and some 1500 persons lost their lives horribly

through exhaustion and drowning. Joseph Conrad, celebrated British author, said a myth had gone to the bottom: "The blind faith in materials and appliances everywhere has received a great shock," he cried. The date was April 14, 1912.

Soon afterward, the International Convention for the Safety of Life at Sea met in London and provided for the "International Ice Observation and Ice Patrol Service in the North Atlantic." More than a dozen nations pay for the Ice Patrol, though it is executed by the U. S. Coast Guard.

In 42 years of actual operations, not one ship, not one life, has been lost in an iceberg collision. This spectacular record contrasts with earlier decades and with the record during World War II when the Ice Patrol was suspended.

Prediction of iceberg drift is the central purpose of the Ice Patrol, the focus of its varied scientific projects. Technicians calculate the size and melting rate of the berg, using the temperature of the sea and the air. Working into their formula the direction and velocity of the currents, the experts make a prediction of where the berg will be at a given time. Frequent sightings of the ice combined with current maps is the central theme of the safety service.

But the Ice Patrol contributes in

many other ways to oceanography, both in the techniques of study and in actual information derived from its surveys and expeditions. For example, *A Practical Method of Determining Ocean Currents*, issued in 1926, is still used by scientists. Equally high value can be put on the research the Ice Patrol has done on the salinity of the sea, on sea temperature, on causes of the Grand Banks fogs, and studies of the upper air. The Ice Patrol has also given America prestige among much older maritime countries.

All this should hearten the American taxpayer. We are all served by ocean-going commerce, and many of us voyage to Europe. In one sense or another, the iceberg is of concern to every one of us.

Harnessing the Berg

The latest suggestion of what to do about icebergs seems as bizarre on first glance as anything could be. Realizing that water shortage has become one of our most pressing problems, Dr. John Isaacs, a member of the staff of Scripps Institution of Oceanography (La Jolla, California), has proposed a plan for towing an antarctic berg to where its fresh water could be used. According to the plan, 6 ocean-going tugs

totaling 80,000 horsepower would be used to tow the berg to the desired locality. Then a special fence of impermeable material would be built to retain the melting ice, which would float on top of the sea water. The water would then be pumped inland as needed.

When questioned about his plan, Dr. Isaacs pointed out that an iceberg 20 miles by $\frac{1}{2}$ mile by 1000 feet deep would contain a year's supply of water for southern California — \$100 million worth of pure fresh water. Possibly it sounds fantastic to tow such a berg 10,000 miles, but the remarkable fact is that some of them have actually made almost half the journey by themselves! Very rarely one has been known to sail across the Antarctic Ocean and down the Humboldt Current. Possibly this tricky navigation could be guided somewhat.

"Although I believe it possible to make the remainder of the trip to California by tow," stated Dr. Isaacs, "it would be very difficult. For the moment, let us consider that the Peruvians could use the water. Actually, in the subtropics, the condensation of water from the atmosphere to the berg would add about 25 per cent to the yield, and recov-

ery of that portion alone would make the entire operation feasible." The "fence" would only have to be about ten feet deep.

Dr. Isaacs estimates that the towing effort would require about 6 months and would cost approximately $\frac{1}{1000}$ of a cent a ton. Thus, possibly an entire year's supply of water for an area like southern California — \$100 million worth — could be delivered (though not distributed) at a cost of only \$1 million.

Edward Hanson ("Iceberg") Smith, who rose to the command of the Ice Patrol and is now a Rear Admiral in charge of the Woods Hole Oceanographic Institution, thinks that the Isaacs concept involves so many problems of transportation, anchoring, distribution, and the like that it is "very speculative but fascinating to an oceanographer nevertheless."

Be that as it may, there can be no skepticism regarding the results of international co-operation in research on icebergs. Commander N. G. Ricketts of the United States Coast Guard, historian of the Ice Patrol, puts it in a nutshell when he says that the Ice Patrol has been a pioneer in international activities and has made invaluable contributions to scientific knowledge.

▼ **ICEBERG. SOUTHERN STYLE.** One of these flat antarctic bergs 20 miles long, half a mile wide, and 1000 feet thick would contain enough fresh water to fill all of Southern California's needs for a year — if it could be towed there.

U. S. Coast Guard



THE NOISY UNDERWATER



EARLY in 1942, a United States submarine operating in the Macassar Strait, in Indonesia, detected a peculiar sound. It was a persistent crackling coming from the sea, without any obvious cause. The submarine carefully circled the area from which the odd noise was emanating but found nothing. The perplexed skipper dutifully reported the incident with the following explanation: "The Japs may have some new-fangled gadget that they drop."

That same year, however, the Japanese themselves were also being plagued with baffling undersea noises. Their submarines had been detecting unusual sounds that strongly indicated the presence of American vessels which, however, never materialized.

Fearing that these inexplicable sounds might wreck the defense of Japanese harbors and coasts, the Japanese Naval Experimental Laboratory decided to conduct a complete investigation and asked the Japanese Hydrographic Department to assist. The greatest experts and scientists at the Hydrographic Department toiled hard and faithfully at the problem. Their final report was a laconic one: "Causes still unknown."

Dr. Yoshio Hiyama, of Tokyo Imperial University, finally solved the mystery in 1944—but American scientists had beaten him to the discovery two years earlier. This feat was one of the best kept secrets of the war.

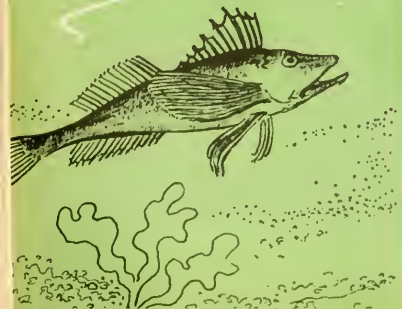
In 1942, the U.S. Navy was putting the finishing touches on a device that was to have a devastating effect on Japanese shipping—the acoustic mine. This operated on a simple but highly lethal principle: it exploded from the noise of a ship passing over it.

But in the very midst of this pro-

gram, highly disquieting reports were coming in from submarine commanders describing a fantastic array of unusual sounds issuing from the sea. These noises seemed to be produced by enemy ships but were definitely not of such origin. They were described in terms that were both poetic and harshly blunt: such as coal rolling down a chute, fat frying in a pan, the dragging of heavy chains, croaking, moaning, whining, grunting, drumming, a subdued steamboat whistle, the rasping of a saw on a strip of steel, the cackling and clucking of a barnyard full of chickens, the "put-put" of a poorly running outboard motor, a badly hurt and groaning man, and so on.

Could these weird noises detonate acoustic mines? This was a question that was giving many a Navy scientist sleepless nights. And what added to the Navy's worries was the belief that these underwater sounds could make a torpedo veer crazily off course and raise hob with submarine listening devices—the educated underwater ears for detecting enemy vessels, without which a modern navy cannot exist.

Thus it was that the Naval Ordnance Laboratory and the National Research Defense Council launched an elaborate and widespread investigation of underwater sounds. They enlisted the talents of an array of specialists in marine biology, acoustics, and other sciences at various government and university laboratories. And these investigators came up with a startling answer. Sounds were being produced by a variety of marine animals such as fish, shrimp, whales, and porpoises. The peculiar crackling sounds heard by the submarine commander in the Macassar Strait, as a matter of fact, were caused by a school of snapping shrimp.



Determining whether undersea sounds were produced by creatures or by enemy traps was crucial to naval forces during World War II. Resulting discoveries may enable future fishermen to lure their catch with piscine love calls.

By JOSEPH BERNSTEIN

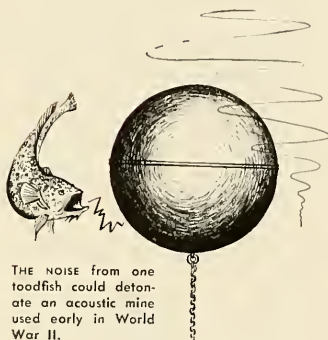
Formerly with the Division of Oceanography,
U. S. Navy Hydrographic Office

Stories now began to trickle through that mines planted by the enemy had actually been exploded by noisy fish. A particularly notorious noisemaker, the toadfish, was then added to determine what it could do to an acoustic mine. To the dismay of the investigator, the noise from only one toadfish was found capable of detonating a mine. It need scarcely be added that the Navy did not breathe easily until changes were made in this type of mine to protect it against such interference.

Fish noises did not first come to the ken of man with the advent of World War II. The ancient Greeks and Romans, with unaided ears, distinctly heard croakers giving vent to their guttural sounds. The Romans called these raucous fish "little crows," and the Greeks did not mince words either in describing them as "grumblers." Marie Poland Fish, a leading authority in this field, has even suggested that the fatal "Song of the Sirens" described in Homer's *Odyssey* may have come from some of these underwater noisemakers. Dr. Fish has been in charge of the Navy's Oceanic Biology Project of the Narragansett Marine Laboratory, Rhode Island, since 1946 and has not only conducted a great deal of the auditioning but has also written the greatest part of the literature concerning research on sonic fishes.

The mariners of Homer's time may have learned through bitter experience that the strange "music" coming from a seemingly calm sea could lure them to shipwreck. The sounds could have arisen from vast numbers of croakers swimming shoreward to spawn, and vessels heedlessly seeking the origin of the noises could quite easily have met their doom on the shoals.

In spite of such ancient knowl-



THE NOISE from one toadfish could detonate an acoustic mine used early in World War II.

edge, recent books and articles describing the adventures of skin-divers, as well as some of the movies about underwater life, give the impression that it is a "silent world" below the surface of the sea. The fishes and other mysterious denizens are supposed to glide noiselessly like ballet dancers in a dream, in this eerily quiet universe of sunken galleons, grotesque coral formations, and gently swaying forests of seaweed. Modern scientific investigations have disclosed that this idyllic picture is only partly true.

Large sections of coastal water are quite intensely noisy at certain times. And some areas may even produce a constant cacophony of loud sounds throughout the year. Nor do all these sounds require highly sensitive listening devices to detect them. Fishermen on trawlers in the Yellow Sea and the China Sea have had their slumbers disturbed on summer nights by a clamorous chorus of croakers shattering the silence of the deep with unmelodic nocturnal music. And Dr. Hiyama, the Japanese biologist referred to earlier, has recently told how pedestrians have been scared by the noise made by vast numbers of snapping shrimp off the sandy beaches of Japan. When the sound was picked up by the hydrophone, it resembled "a sudden brush fire."

The hydrophone is the basic instrument in the study of underwater sounds. It is nothing more or less than a microphone adapted for underwater use. Like all microphones, it magnifies the sound it picks up. The sound is then fed into an analyzer unit, which separates it into its basic components. The sounds are recorded either on discs or tape. These records can, of course, be played back, so that the various characteristics can be studied in detail and compared with other sounds. Where the noise is a confused jargon, the analyzer serves to separate the individual sounds according to the different octaves. Each pitch-range can then be separately recorded. In this way it is possible to isolate and identify the different noise producers, either as soloists or as a chorus of their own particular species.

With such equipment, the scientists have been taking a Gallup Poll among fishes in waters throughout the world, and under varied conditions. Hydrophones were stuck in the tanks of time-honored piscine residents at Narragansett Marine Laboratory and also at the Shedd Aquarium in Chicago, as well as in open waters where fishes could be trapped in wire enclosures.

No attempt was made to spare the feelings of these unhappy creatures, which were often unceremoniously dumped into strange surroundings in order to see (or rather, hear) how they would react. They were annoyed, prodded, shocked with electricity, starved, packed into tight quarters with other fish, scared with strange and loud noises, and forced to vie with one another for supplies of food. It is little wonder that these harassed fish gave vent to their upset emotions with whatever croakings, moanings, and gnashings of teeth their sound-

making apparatus could produce.

On the other hand, they were also auditioned after they had been given sufficient food and had otherwise become reasonably content with the state of things around them. They were even recorded during their amorous moods. All these sounds were industriously analyzed and filed away for reference in the unique Reference File of Biological Underwater Sounds maintained at the Narragansett Marine Laboratory.

We ordinarily think of an animal's noise-making powers in terms of its voice mechanism—that is, a mouth, tongue, larynx, windpipe, and lungs. But Marie Poland Fish has pointed out that these creatures rely on an entirely different set of organs to produce their sounds. The most important of these in many fishes is the swim bladder, a membranous bag filled with gas, which is also used for buoyancy. The reason why this bladder can play the role of a "voice box" is that muscular contractions can make both the walls and the enclosed gas vibrate.

When you detect low-pitched grunts, thumps, growls, and tomtom beats underwater, you can be reasonably certain that a vibrating swim bladder is the musical instrument involved.

Sometimes this basic apparatus is given an added refinement when thin muscles stretch from the bladder to the backbone. When these muscles vibrate, they add the subtler effect of plucked violin strings to the coarse drumbeat of the swim bladder.

A most elegant demonstration of this is found in catfishes. The fourth vertebra forms a spring which rests on the swim bladder. Muscles are stretched tightly from this spring to the back of the skull. When these muscles vibrate, the sound produced is amplified by the rhythmic vibrations of the swim bladder. The sounds are like those made by a soft-shoe dancer performing on top of a hollow barrel.

Not entirely satisfied with such elaborate stringed-instrument effects, catfishes can vary their mu-

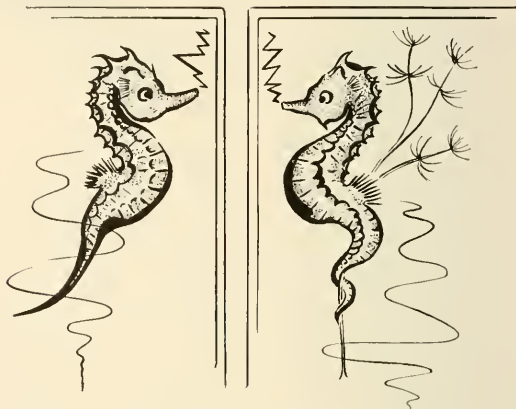
sical renditions by scraping their vertebrae against each other. The result, according to the aquaphonic Marie Poland Fish, is "a harsh scraping noise."

Other fishes that produce an elaborate array of scraping and rasping sounds include certain kinds of sea horses, threadfishes, triggerfishes, and sculpins.

Sculpins, for example, show annoyance or alarm by moving their pelvic bones, producing a buzzing sound. When the giant ocean sun-

other fish, can be heard throughout the summer months. The gentler moods of the sea robin are expressed by sounds like the rubbing of a finger against an inflated rubber balloon, although one unkindly critic has stated that the noise was like a musician plucking monotonously on one string of an untuned harp. The sudden outburst of grunts from a sea robin in an aquarium has been known to startle uninitiated observers.

While the croaker cannot out-



TWO SEA HORSES in adjoining aquaria were reported, 50 years ago, as holding an earnest conversation. It is known today that sonic fishes respond with anger, fear and surprise.

fish is hauled out of the water, it often displays its displeasure by gnashing its teeth quite audibly and unmelodiously. Puffers express their feelings by rubbing their jaws together.

While more and more fishes have been found capable of emitting sounds of one sort or another, not all of them are very important contributors to the music of the undersea world. The stellar performers, the truly great artists in the rendition of fish music, are actually few and far between.

A roll call of the loudest and most persistent sound producers may well start off with the sea robin. This is perhaps the most loquacious fish along the north Atlantic coast, and its grunting concerts, unlike the restrained and sporadic performances of certain

grunt the sea robin individually, it is nevertheless the most important noisemaker in the waters off American coasts. The reason for such pre-eminence in the fish concert is that this fish accumulates in very large numbers in inshore bays. When this happens, there is frequently considerable interference with underwater listening devices. Croakers get enthusiastically vocal in the evening, and in Chesapeake Bay they sound like "a forge shop in full production," or a "pneumatic drill working in concrete," according to scientists who have listened to their raucous concerts.

Why do fishes make noise? One obvious explanation is that the sounds are actually used as a means of communication. Theodore Gill, the celebrated ichthyologist, gave an engaging description a half

century ago of two sea horses in separate aquaria holding an earnest conversation. One fish made short snapping noises at regular intervals, and the other replied with an almost identical pattern of sounds. Whether they were expressing a deep and abiding affection for each other, grief at their captivity, or contempt for ichthyologists, was not discovered.

It is now known that sonic fishes respond with noisy exclamations of wrath, fear, and surprise pretty much as other animals higher in the scale of life do. We must definitely abandon the notion that they have to suffer their grievances in mute and stoic silence.

The "mating call" is scarcely a novel phenomenon in the animal world. What is fairly new, however, is the knowledge that it is a standard device among some fishes during the breeding season. Marie Poland Fish has vividly described the way croakers use noisemaking for assembly purposes during their spawning period:

"Infrequent solos announce the arrival of the first mature specimens; then a loud symphony of

mingled croaking is heard at the height of the season; finally the sounds taper off gradually as the dense schools break up."

Other sounds seemingly serve no useful purpose but only reflect the fish's eating habits. Some fishes are noisy eaters, particularly those that crunch the shells of mollusks between their powerful teeth in order to get at the succulent flesh. The bottom-feeding skates and rays are prime producers of such noises.

The most intriguing use that fishes make of their sound equipment, however, has been suggested by D. R. Griffin, of the Department of Zoology at Cornell University, as a result of recent observations. Recordings made by investigators of the Woods Hole Oceanographic Institution indicated in one case that the loud calls of a marine animal were followed by faint echoes. The explanation offered by Dr. Griffin is startling but plausible: that the fish was echo-sounding in order to orient itself at a proper depth. He suggests that many other fishes may be capable of doing this.

This implies that echo-sounding fishes have a good sense of hearing.

And experiments have indicated that some fishes, at least, such as the European fresh-water minnow and the common catfish, have a hearing apparatus quite as sensitive to sound as the human ear. That sea robins can also hear was demonstrated by educating them to strike at a sound signal in order to get food.

Several years ago an utterly meaningless expression, appealing to a nonsensical urge in many people, had a considerable vogue. The expression was "Who's Yehudi?" and mercifully it eventually died out as a source of humor. But it was revived in an odd and sinister guise among submariners operating in the Aleutian Islands.

Many submarines in this area during World War II had been picking up a strange noise that sounded like a combination of propeller-beat and a steady clicking. While in many cases it sounded like enemy craft, such a source was always ruled out on investigation. Every other explanation proposed also proved inadequate. It was not long before these weird noises were called "Yehudi." But who Yehudi was, no one had the faintest idea.

"Heard Yehudi noises again on starboard bow," reads one of the Submarine War Patrol Reports, "moving left to dead ahead and finally around to port bow. Sounds like a pile driver. Radar clear."

When persistent investigation eventually traced these mystifying noises to their actual source, Yehudi was found to be nothing more or less than whales and porpoises.

Other oceans abounding in whales and porpoises also befuddled submariners with similar puzzles. One report from the Solomon Islands stated:

"Besides the usual clicks, wheezes, and whistles previously encountered, we frequently picked up a noise similar to a reciprocating engine with a loose bearing. This turned out to be from whales."

Whales and porpoises are nosy as well as noisy, and their amiable curiosity has induced them to follow many a submarine quite a distance.



MRS. MARIE POLAND FISH records the clicks of a sea robin as she administers electric shock. On the bottom of the tank is a loachfish, the loudest underwater noise-maker.



The Circus Seal

at Home



The California sea lion needs only to be left unmolested to become a friendly and interesting neighbor

By KARL W. KENYON*

U.S. Fish and Wildlife Service
Photographs by the author



A CLUSTER of pointed, black, finlike objects rose and fell with the even rhythm of the ground swell a hundred yards or more beyond a gently breaking surf. The Southern California sunshine glistened on the objects, attracting the attention of a group of eastern tourists clustered on a low bluff near by. They watched the strange "fins" through binoculars and concluded that they belonged to a school of resting sharks. Suddenly, a doglike head emerged from among the "shark fins" and emitted a series of honking barks; and the startled spectators realized that the "shark fins" were flippers that belonged to sleeping "seals." Actually, they would have been more correct had they recognized the animals as California sea lions, *Zalophus californianus*.

This sea lion, so widely familiar as the trained "seal" of circuses, zoos, and carnivals, is almost universally called a seal. The hair seal or harbor seal is a very different animal and is the one more properly termed a seal.

For the most part, sea lions enjoy a placid and carefree existence along the California and Mexican coasts. True, they are sometimes shot at by fishermen and are often damned roundly by seashore resi-

◀ PHOTOGRAPHED ONLY a short walk from La Jolla's business district, this "wild" sea lion could be approached to within about three feet without a "blind."



▲ LIKE ALL SEALS, California sea lions shed copious tears when they lie in the warm sun, but it doesn't mean that they are sad.

dents for early morning vocalizing. To verbal abuse they are oblivious; and when they stay away from human fishing activities, they spend their days at ease on a deserted bit of rocky shore or at favored resting spots on the sea's surface close to a local feeding area.

Unlike the other two members of the family of the Eared Seals (*Otariidae*) that live along our Pacific coast, the California sea lion chooses to spend his days entirely in a temperate climate. His northern relatives, the Steller or Northern sea lion and the northern fur seal, range more widely into the rough waters and wind-driven fogs of subarctic seas. The ranges of all three overlap regu-

larly only along the Oregon and northern California coasts during the winter months.

To visiting tourists the sea lions present an unusual and interesting spectacle. To the patient animal trainer they represent the source of a livelihood, and to the holiday crowds at circuses and zoos they are an unending source of entertainment. A sea lion in captivity is a natural show-off and even when not performing in a regular show will often put on an unscheduled one for spectators gathered near its pool. One such animal in the Fleischecker Zoo at San Francisco, after being fed by the keeper, pretends that something is caught in her throat. Her contortions—as if strangled—were

so realistic that a sign was posted to keep sympathetic spectators from repeatedly calling the keeper to administer first aid to an apparently dying sea lion.

Sea lions in the wild often have spectators not in the least entertained by their antics. In fact, the hard-working fisherman uses unprintable words to describe the sea lion when he sees them on his fishing grounds. His antipathy toward the animals is not unfounded. Sea lions will slip into fishing nets, panic, and then break through, with the fisherman's entire catch following. If sea lions approach a live bait boat that has "baited up" a school of fish, the intruders will swim among them, and fishing is over in that spot for the day. Fishermen therefore claim that besides damaging gear to the tune of hundreds of dollars, they also waste a good many fishing days.

Thus, the value of a sea lion may vary between extreme limits, ac-

*Since 1947, the author has worked with the Branch of Wildlife Research of the U. S. Fish and Wildlife Service, specializing primarily on population studies and other biological aspects of the Alaska fur seal on the Pribilof Islands and at sea off

North America and Japan. Last summer, Mr. Kenyon spent two months on Anichitka Island, in the Aleutians, conducting a study of the sea otter, and he plans to continue the project this summer. He is a native of La Jolla, Calif.—Ed.



➤ IN CAPTIVITY, the California sea lion quickly endears itself to the public. When jumping for food, the supple neck looks even longer than usual. Sea lions have particular aptitude in balancing and in learning to play tunes by rote.

According to one's point of view. If you ask an animal trainer how much a sea lion is worth, he may say between \$4000 and \$5000, but a fisherman will probably tell you he would gladly pay good money just to get them out of the way.

In between these two extreme points of view, sea lions have in the past lent themselves to various forms of exploitation. Lake Merced, near San Francisco, once became heavily infested with carp. In 1891, nineteen sea lions were liberated in the lake, and shortly thereafter it became necessary to employ a crew of men to collect the pieces of fish that littered the shore. Within four years, the fish were nearly gone, and the sea lions were still on hand to keep them under control.

Dr. W. J. Ross, an enterprising but rather ruthless man, probably exploited the sea lion more efficiently than has any other person. He operated a killer ship, a factory ship, and a tender which raided sea lion breeding colonies on the beaches of the rugged coastal islands of California. Here he slaughtered thousands of animals and converted their carcasses into Dr. Ross' Dog and Cat Food. That is, he did until naturalists and conservationists promoted, in 1937, legislation forbidding the killing of sea lions along the California coast. Ross then shifted his activities south of the United States border, until an international agreement stopped him entirely. Now, the killing of sea lions is prohibited in California except when fishermen

find them actively interfering with their activities.

One claim that fishermen make seems almost entirely unsubstantiated. This is that sea lions consume millions of dollars worth of commercially valuable fish each year. Various computations have been published, some claiming that a sea lion will consume as much as 50 pounds of fish a day. The facts available, however, indicate that 8 to 10 pounds of fish a day are sufficient for most trained seals and zoo animals, while large animals will consume as much as 24 pounds. The stomach contents of animals killed in the wild contain similar quantities and also reveal that sea lions feed, to a large extent, on species considered as trash fish by most fishermen. Eight sea lions killed by salmon fishermen near Monterey, California, contained only squid and octopus. These appear to be staple items, but other stomach analyses reveal that dogfish, morays, deep-water crabs, and herring are also eaten. Food of commercial importance seems to be rather unimportant in their diet.

No recent census of California sea lions is available. However, the number in California waters probably exceeds 5,000. The only other place where they breed is along the coast and Gulf of Lower California. A few frequent the coast of Oregon to the Columbia River, and they are recorded infrequently from Washington and the outer coast of Vancouver Island. Adult males appear to winter farther north than the females and can be distinguished from them by a crest on their heads. Also they weigh 500 pounds or more, whereas the females range from 100 to 200 pounds.

A breeding sea lion colony is a noisy place. The air is filled with a chorus of honking barks and grunts. For the most part, breeding grounds are located on remote beaches of offshore islands. The cow bears a single pup each year, usually in June, and, like the northern fur seal and Steller sea lion, mates again soon after the birth of her pup.



▲ DURING THE WINTER, about 1000 sea lions haul out in this sandy cove near the tip of Point Reyes in central California. The animals appear to be mostly adult and subadult males.

▼ THE MALES show a sociability in winter at Point Reyes that differs considerably from the belligerence they display toward one another during the breeding season.

Like the young of other eared seals, the California sea lion pup prefers to remain on land for at least eight or ten days before trying its strength as a swimmer. After the pup takes to the water, the mother may come up under her baby and carry it for a short distance on her back, as described by Mrs. Benchley of the San Diego Zoo. I have watched northern sea lions do this near a breeding beach on the Pribilof Islands, in the Bering Sea. Young fur seals do not seem to do it. And contrary to the statements that one sometimes hears, all these animals are able to swim without lessons from the mother. They improve their skill and increase their strength by taking first short, then longer swims



from the rocks of the breeding beach.

Although the California sea lion bull maintains a harem of several cows, the harem structure is more loosely organized than that of the northern fur seal. They often breed in captivity. Several have been born in the San Diego Zoo, and Mrs. Benchley tells us that the young nurse for a period of about six months.

The capture of sea lions in the wild is a strenuous undertaking. Many of those captured during the past fifteen years or more were taken by Mr. John Zolezzi on the Coronado Islands, just south of San Diego in Mexican waters. Zolezzi spreads a net in the water a short distance from a place where the sea lions habitually haul out. After the net is spread, he fires a few gunshots over the heads of the sleeping animals, and in the splash-

ing stampede that follows many become entangled and can be hoisted aboard his boat. The wild animals are worth about \$25 apiece. It takes many months or even several years of training to produce a seal that may be worth several thousand dollars.

Intelligence and adaptability to training varies among individuals. One animal may learn tricks in three months that take another seal six to twelve. Trainer Mark Hauling, who runs Seal College in Kingston, New Jersey, valued Sharkey, an exceptionally brilliant performer, at \$75,000.

The sea lion is a sensitive and delicate animal and must be treated with care and kindness. Punishment, such as slapping, destroys confidence in the trainer and renders training impossible. Reward, not punishment, is the key to the sea lion's mind. Once trained,

usually a three-year process, the sea lion's career as a trained seal may last as long as eight to twelve years. Some reportedly have performed as long as seventeen years. The life span, as indicated by various captive animals, is probably about 20 years.

However, occupational hazards tend to reduce the useful years of a trained seal. Flippers are easily punctured by nails or other sharp objects, and the protruding eyes are damaged when they brush against walls and other objects. Cataracts develop, and sometimes the sea lion becomes completely blind. One such blind performer, which had become accustomed to going from the "dressing room" to the stage, continued performing for five years despite his infirmity.

Even wild sea lions, if carefully protected, may show a remarkable degree of tameness. A group of five

▼ ADULT MALES are easily distinguished from other seals and sea lions by a prominent crest on top of the head. Light-colored hair surmounts the mound of flesh and bone.





▲ THEY find their fishing grounds close to shore and rarely venture far out. Their sharp-pointed teeth are well adapted for grasping and tearing the slippery fish and squid on which they feed.



▼ EVEN THOUGH this bull's harem of cows has not yet arrived, he is hostile and is charging the photographer.

animals that lay sunning themselves on the rocks at La Jolla, California, allowed me to approach them to take some of the accompanying photographs from a distance of three feet. However, if the animals are shot at, they become so wary that they challenge the skill of a practiced stalker to get within gunshot range.

Although frolicsome sea lions appear to be among the healthiest of animals, they are not immune to disease. Because of their diet of raw sea animals, virtually every sea lion is heavily infested with parasitic stomach and intestinal worms of several species. Generally speaking, we have no evidence that such parasites interfere materially with the sea lion's health. However, stomach ulcers, which many seals have, may become the anchor spot of a hundred or more worms, and if the ulcers perforate, they may result in the animal's death.

A few years ago hundreds of sea lions washed ashore dead or dying along the coasts of Cali-

fornia and Mexico. Although the disease of which they died was not accurately determined, observers reported that the lungs were congested and the symptoms were similar to those of pneumonia.

The number of animals killed by fishermen is probably quite constant but not large, and it is clear that the sea lion population has increased in recent years along the California coast.

Natural enemies, such as killer whales and the great white shark, probably kill only a negligible number. Dr. David Starr Jordan once found a young sea lion in the stomach of a great white shark. Older animals undoubtedly escape most such assailants. Man is the greatest enemy. The illegal destruction of sea lions on their breeding grounds in a cruel and wasteful manner has long been disturbing to naturalists and conservationists. Several instances are recorded where marauders have landed and slaughtered the animals unmercifully on breeding beaches and left the bodies wasted and rot-

ting where they fell. Often small bore rifles were used, causing the animals to die a lingering death.

Except during the breeding season, sea lions are not dangerous. One rare exception has come to my attention. I was told of a case of a swimmer who was diving. A sea lion swam up behind him and nipped him slightly, perhaps in play or curiosity. The bulls are aggressive in defending their chosen bit of breeding beach during the mating season, and if a person were caught by a charging bull at this season he would undoubtedly suffer a nasty bite.

Controversial as the sea lion appears to be, it goes on quietly basking in the sun, fishing and breeding along our coast. If it is shot at, it "wises up" quickly and avoids boats or plunges into the sea at the approach of man. It chooses the most deserted spots on rocky, wave-heaten shores to bring forth its young. Yet, if it is protected, it soon loses fear of man to become an interesting part of the seashore scene.



Paintings on Cobwebs

Unknown to the rest of the world, artists of a Tyrolean valley sought to express their spiritual devotion through infinite patience on the most difficult "canvas" imaginable

By INA CASSIRER*

Reference Librarian, Art Division, The New York Public Library



THIS unique and interesting folk art was originated by primitive peasant craftsmen over 200 years ago in a remote valley of the Tyrolean Alps. Religious devotion was the motive that inspired these people to develop a technique for painting on one of the most fragile materials in the world—cobwebs gathered from shrubs in their gardens or in the attics of their houses.

The writer became fascinated by this "Lost Art" upon learning that there is hardly anything in print concerning it. I went to Europe last year to try to gather further information in the region where it originated. In Innsbruck, I found that Dr. K. Toldt, an octogenarian zoologist and folklorist, was deeply interested in this forgotten craft, and he freely transmitted his knowledge in the desire to make it more widely known. It was also thrilling to accompany Dr. H. v. Wieser, librarian and collector of cobweb pictures, to the romantic Ambras Castle and there to discover in the back of a dusty cabinet four of the old paintings that until now had been unknown. You may imagine the gracious manner in which my interest was received when I tell you that upon my departure, Dr. Wieser gave me as a farewell present one of his treasures—a charming cobweb picture by Burgman.



▲ THE CHARM OF THE PAINTINGS lies partly in the fact that the background areas are left unpainted, so that the figures seem to float in an opalescent haze. This fine example was painted by Johann Burgman, a pupil of the "inventor" Elias Prummer, none of whose work survives.



◀ BRUNECK as it appeared in 1619, a town whose rich artistic tradition influenced the evolution of spiderweb art in this valley.

▼ A VIEW OF THE TOWN OF S. Candido in the Puster Valley, the region in which cobweb painting originated.



L. Franzl

So little is known about these pictures that when I recently wrote to the Vatican Library for additional material, the Director of the Vatican Museums and Galleries informed me that they had never heard of such pictures and asked me to give him what information I might gather. An inquiry at the Library of San Marco in Venice brought the same answer, as did one to the Administration of Fine Arts for the Venice region.

The desire of the peasant to prove his belief by giving the best of his talents in the creation of these devotional pictures makes us think about the beautiful legend of the poor juggler of Notre Dame. Since he had nothing else to give, he put on his best performance in the church for the Madonna he loved so much. "I will serve the Mother of God according to my trade," he said to himself. "Others serve in chanting, I will serve in tumbling." So he spread his old carpet in front of the altar and put so much effort into his jumping and tumbling and dancing that he finally fell unconscious. Whereupon the Madonna, radiant with a smile,

stepped down from her pedestal and covered him with her wide blue coat.

It is surprising that in spite of their fragility, over 100 cobweb pictures are still in existence. Most of them are in private collections, where they have been cherished for generations. A few are preserved in cloisters and local museums.

Many of them were painted in water colors; some pictures were even printed on cobweb from plates like regular engravings. Others were fine-brush drawings in India ink. So far as I have been able to find, cobweb has been used nowhere else in the world for such a purpose. These artists used either spider web or the silky transparent web of caterpillars—mem-

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branes woven out of silk threads produced in the bodies of these creatures.

Source of the Web

The webs used included those spun by the funnel-web spiders of the family Agelenidae. They were either the silky sheet web of the grass spider, *Agelena labyrinthica*, or the web of the common house spider, *Tegenaria domestica*. The small sheets of *Agelena* are quite a common sight in the European countries, where they can be seen scattered over grass and bushes, glittering in the early morning with drops of dew. *Agelena labyrinthica* is unknown in the United States, but several relatives spin similar webs here—should anyone be thinking of trying to duplicate this art. In June, when the spider is immature, this sheet web is very thin and small. Gradually, through the incessant spinning of the spider,

the web grows, and in August it becomes a quite expansive blanket, satinlike and dense in the center.

If given a chance, the house spider, which is a close relative, also spins a web that is large and dense enough for a picture. The large species known as *Tegenaria atrica*, if left undisturbed in an attic, will sometimes produce a sheet almost two feet long. It seems, however, that the craftsmen were prompted to look elsewhere, owing to special problems in the use of these webs. The main trouble lay in their extreme fragility, in the difficulty of stretching them without breakage, and in the frequent presence of foreign bodies which impaired the web's transparency.

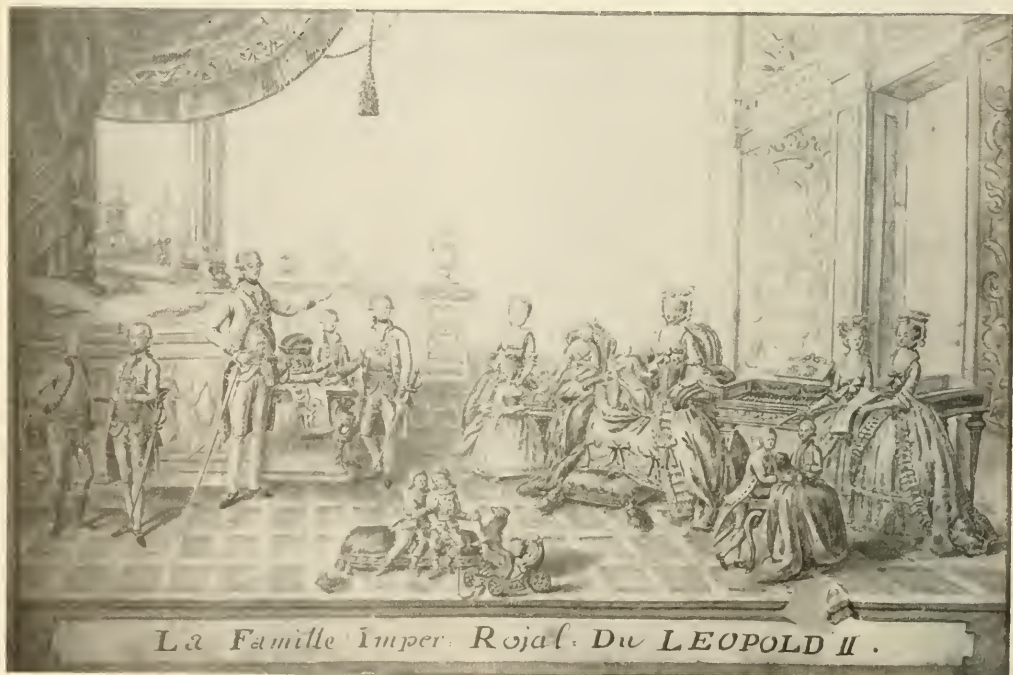
They found the material they were looking for in the fine silky gossamer spun by the caterpillar of a small silver-gray, black-spotted moth known scientifically as

Hyponomeuta evonymella Linnaeus. These caterpillars, which are almost hairless creatures about three-fourths inch long, sometimes appear in masses in the particular mountain region where the art evolved. In the spring, they wrap their web around the branches of fruit trees, especially those of the bird-cherry tree (*Prunus padus* Linnaeus), locally known as "Elzen-Stauden." This grayish-



▼ A BRUSH DRAWING in India ink. The lines are so fine one might suppose a pen must have been used, but a pen would have torn the web. The artist probably used a fine feather brush. The date: 1799.

▲ A SEVENTEENTH-CENTURY view of Castle Ambras, near Innsbruck, where the traveler today can see several cobweb paintings.





© Walter Scott Bradford

▲ THE COBWEB PAINTING that resides in Chester Cathedral in England; a miniature copy, probably by Burgman, from the Maria-Hilf Madonna.

JOHANN BURGMAN's water color of "The Lamb of God and the Book of Seven Seals." The lamb symbolizes Christ and a banner, His martyrdom.

Demaree



Johann Burgman

white, transparent web can be cut from the tree with a knife and removed with the finger tips in pieces sometimes as much as two feet long and one foot wide. It has the advantage of not being so fragile or dirty as spider web often is, and when crumpled, it can be unfolded again and easily stretched.

Spider web is the creation of an individual, whereas caterpillar web is the work of a team. Both, however, are woven of fine threads of a very similar type of silk. This silk is elastic, and it has considerable tensile strength. It is much finer than the silk produced by the "professional" silkworm. The thickness of silkworm thread ranges from 13 to 26 microns (about 1/2000 to 1/1000 inch). Spider silk threads, however, vary from only about 1/1,000,000 inch (.03 micron) to heavier threads of 2 to 3 microns (1/12,000 to 1/5000 inch). The silk thread of caterpillars also has a rather uniform thickness of about 2 to 3 microns.

Spider silk is produced by several abdominal glands, whereas the silk of caterpillars comes from salivary glands located in the head. In their chemical protein composition, both types of silk are quite similar.

The two kinds of webs have a different structural arrangement. The spider builds a framework of long double or triple draglines, upon which it spreads a loose mesh of many fine fibers applied in various directions. Caterpillar webs, on the other hand, are spun out of almost uniform threads, which cross each other densely in a slanting manner.

In the scarce old writings about these paintings, the term "cobweb" seems to be used for both kinds of material. And no difference between them can be seen with the naked eye. It requires microscopic examination to establish the type of fabric that the artist has used for his "canvas." Several of the pictures were recently examined in this way, and only one of them proved to be painted on spider web; the others were on caterpillar web. In many cases, thorough ex-

amination is impossible because of the danger of damaging the picture while taking it out of the frame and manipulating it.

Before beginning the painting, the artist cleaned the web and stretched it on cardboard. Sometimes, in order to obtain a more resistant background, the web was sized with milk diluted in water. Johann Burgman, who was the most representative and prolific of the cobweb painters, put nuts in the water he used for painting because it made it oily, according to an account of his technique in a handwritten biographical dictionary of local artists.

How It Was Done

The majority of the pictures were painted in the regular miniature technique, with opaque water colors (water colors with some white added). Parts of the transparent background were usually left unpainted in order to show the unusual fabric. Details such as hair and eyes were drawn in with minuscule brush strokes. Tiny flowers, ribbons, and garlands, which often surround the central image, were put on heavily in the impasto manner. The artists sometimes painted a small spider or an insect in a corner or at the bottom of the picture to call attention to the material and to the exceptional skill required to paint on it.

There are also a few brush drawings in existence that were made in India ink with wash. They are so fine that they might have been drawn with a pen but for the fact that a pen would surely have torn the web. More likely, the artists worked with an extremely fine brush made of snipe (woodcock) feathers, achieving with it very fine hairlines and exceptional tonalities in these black-and-white drawings.

Perhaps most astonishing of all are the engravings that have been printed on cobweb. It is almost impossible to imagine how the breath-fine gossamer could withstand the complicated process of printing with metal plates. The cobweb had to be stretched flat on



▲ ENGRAVINGS PRINTED ON COBWEB demanded the ultimate in dexterity. This "Abgar" portrait of Christ, from a plate by J. H. Storchlin about 1730, is one of only six engravings known today.

the blackened plate, then exposed to the heavy weight of the press, and finally pulled off. The technique demanded extreme dexterity and finger-tip skill. It is not surprising that only six such engravings are known today. Apparently not many of them were ever made.

One of the main attractions of cobweb pictures was their effect of transparency. When held against the light, they can be seen just as well from the back as from the front. This is why the artist stretched his picture in a narrow cardboard frame that left the central image free to be enjoyed from both sides. The frame was usually decorated daintily; and sometimes the picture was surrounded by handmade golden lace instead.

It was a popular custom to hang these pictures in a window or in

any other place where they could be seen against the light. They were then mounted between two glass plates in a fine wooden frame, which was decorated identically on both sides.

The average size of the cobweb paintings is that of a large postcard, about 7 inches high and 4 inches wide. A few are larger; and the smallest, an engraving, measures 4 inches in height and 2½ inches in width.

The writer searched the Tyrolean archives for information about the origin of cobweb pictures and the artists who painted them but found very little. Scattered brief notices in old local artists' records, and references in the unpublished manuscripts of collectors such as have been preserved in archives and among family possessions, indicate that the cradle of this

▼ A SPIDER painted in the lower right corner calls attention to the use of cobweb as canvas. Its prey, the fly, is at the upper left. Portrait of the Bishop of Brixen Carolus A. Lodron, by Burgman.



peculiar art was in the Puster Valley (Pusteria) in South Tyrol, particularly in the neighborhood of Bruneck (Brunico).

Bedded between icy peaks and the fantastic world of the Dolomites, the peaceful valley has a long cultural and artistic past. There were already many cloisters, parishes, and castles, some dating from as far back as 770, when Bishop Bruno of Brixen founded the town of Bruneck in 1251 and named it after himself. It is a particular feature of this mountainous valley that all the spiritual, social, and economic forces that determined its life through the centuries have remained closely integrated with the landscape. The white glittering churches in town and village, and the chapels and wayside shrines scattered on soft green slopes, seem to be inseparable



WHEN COBWEB PAINTING was revived in the 1870's, nondevotional subjects like this were produced. It is a copy of a picture by Franz von Defregger, a famous painter of Tyrolean peasant life.

from the scenery; and they reflect the power of the religious thought that formed and directed the lives of these people.

Sponsored by the Church, the artistic life of the valley was already flourishing in the Middle Ages. Even before the great painter and wood carver, Master Michael Pacher, set up his workshop in Bruneck in 1467, the Master Hans of the same town was the most sought-after church painter of the whole region.

The rich wall paintings and altar pieces that are still preserved in many of the churches, and the façades of old houses decorated with paintings and wood carvings, give proof to the long artistic tradition. Similarly, the ruins of the old castles that are perched high on the cliffs above the river tell the story of proud and mighty land-graves who were world-famous for their libraries and art collections.

It was only natural that amid such surroundings folk art should flourish. The village craftsman had ample inspiration for his creative work, and usually he was a master of all trades: church painter, wood carver, and glass painter. The field

of his activity depended upon the demands of the community, and he was kept busy supplying decorative objects for the church or for the house. Among the most cherished objects for adornment of the home were devotional pictures. There was not a single house in the valley that would not have in its *Stube* ("best room") one or more of these religious pieces.

In its origin, the devotional picture was simply a miniature detached from the early prayerbooks. In the Middle Ages, when religious mysticism was at its height, people desired to have religious images close to them for purposes of meditation and edification. In women's cloisters, which were the centers of religious education, images of miraculous saints, Passion scenes, and other sacred subjects were painted by nuns on parchment and silk and given out as loving gifts. Gradually these pictures left the seclusion of cloisters to become objects of popular enjoyment. In the seventeenth and eighteenth centuries, within the powerful wave of the Counter Reformation movement, the devotional pictures became an essential factor in the religious culture of the Catholic countries, particularly in southern Germany and Austria, and they reached the most remote regions.

Side by side with the works of professional artists, which gradually came into mass production, appeared pictures made by local craftsmen, in which the loving playfulness of popular art manifested itself under the discipline of devout and patient perseverance. Some of the pictures were meticulously embroidered; others were painted on glass. They were cut out of paper; they were made of feathers or lace. All these naïve and delicate creations, which required so much patience and manual effort, were inspired by the desire to accomplish the best, the utmost in beauty. Love and devotion were their incentives; and the more fragile they were, the more they were cherished.

It was one such craftsman of the

Puster Valley, Elias Prunner, who is known to have "invented" the painting on cobweb. Was it the isolation and remoteness of the valley that forced him to look for material available at home? Or was it a playful fancy, so typical of folk art, that made him try out the fragile gossamer? We cannot answer this definitely; but during the long winter, when the village was fast asleep under the heavy snow, he had time enough to practice his patience in painting on cobweb.

All we know about Elias Prunner is that he was active around the middle of the eighteenth century and that, although he was recorded as a "mediocre" artist, his pictures were much sought after. An amusing description of his pictures is given by the famous Tyrolean art collector Carl Joseph von Weinhart, who lived from 1712 to 1788 and compiled a four-volume, handwritten catalogue of his treasures: "Miniature, also India ink and watercolor painting. A small piece in a brown frame, between two glass plates . . . by Elias Prunner from the Puster Valley. Elias Prunner, a mediocre painter, betook to paint on spider web with watercolors. Some say that he raises spiders for this purpose, others claim that they are worm nests on which he paints because such spider web cannot be had. His son assured me that it is the first, adding that he (his father) knows the secret how to obtain spider webs . . ."

An Empress' Delight

The originality of Elias Prunner's cobweb pictures caught even the fancy of the Empress Maria Theresa, who loved and collected all kinds of devotional images. During the summer of 1765, she came to Innsbruck to attend the celebration of her son Leopold's marriage to the Spanish Infanta Maria Luisa. In the presence of the entire court Elias Prunner, who came to town for the festivities, had the good fortune to show his pictures. The Empress not only

continued on page 210



▲ CLUMPS OF THE LICHEN *Cladonia evansii* carpet the floor of a pinewoods near Cocoa, Florida.

▲ ONE OF THE CLUMPS. When light streams through the lichen it looks no more substantial than a clot of foam on a beach.

Sponges of the Land

Wet the pineland lichen and it will absorb moisture and expand like a sponge, and give off a rich, mushroomy scent.

By EDWIN WAY TEALE

LIKE thousands of little silver-tinted sponges, clumps of the lichen *Cladonia evansii* Des Abbayes extend across the fallen needles of sandy pinewoods in many parts of Florida and other sections of the southeast. Each clump is about three inches high. It is formed of an interwoven maze of many-branched growths. Placed in water, such a lichen clump will quickly lose its stiffness and, spongelike, rapidly increase its size and weight with absorbed moisture. When wet it gives off a

rich mushroomy scent. After being in water for only five minutes, one three-inch clump weighed six times as much as it had when dry.

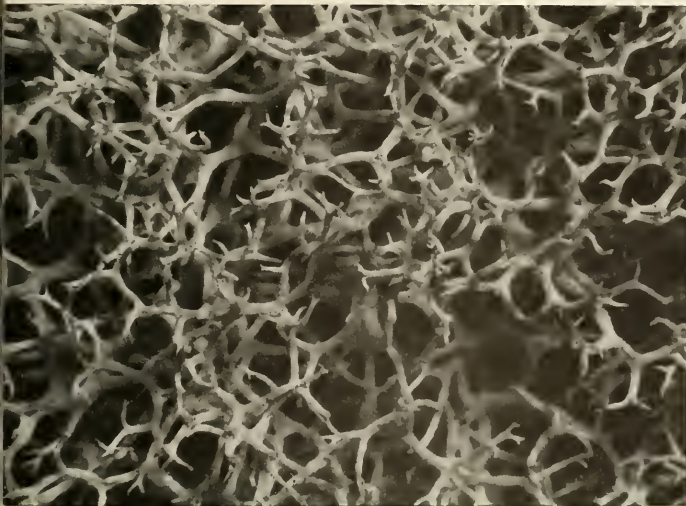
As are all other lichens, these curious little "land sponges" are double plants formed of a fungus and an alga growing together in a partnership so close their tissues can be distinguished apart only under a microscope. The *Cladonia* group, to which the pinewoods lichen belongs, is the most widespread and varied of all the lichens of the Western Hemisphere. The

familiar red-cupped species called "British soldiers" is a member of this group. So is the widespread "reindeer moss" that ranges from Florida to the arctic. Common names, comparing the plants to goblets, trumpets, powder horns, funnels, and spoons, reflect the variety of forms that are found among the *Cladonia* lichens.

The habitat of *Cl. evansii* is always a sandy pine flat. Its range extends from North Carolina into peninsular Florida and west into Louisiana. It has also been reported from Cuba. Sometimes the fairy forests of these lichen clumps extend for acres across the woodland floor. When the sun streams low through the pine trees and the filmy masses of lichen are shining in backlighting, they appear no more substantial than puffs of steam or clots of foam on an ocean beach.

Almost always the double plant rises out of needle-strewn sand. On rare occasions it is found growing on old wood. As the lichen ages, its shining gray tends to darken like tarnishing silver. Occasionally an isolated specimen will be tinted with a greenish cast or a pale yellowish tinge.

The greatest enemy of these airy little clumps of the pinewoods is fire. When flames, creeping through the fallen needles on the floor of the forest, come to the stand of lichen clumps, they advance with a rush and consume them all.



▲ A CLOSE-UP SHOWS the interlacing branches of growth that form the airy mass of the lichen clump.



▲ THE MALE AND FEMALE QUETZAL, right, symbol of freedom, keyed the objectives the authors pursued in their studies of the tropical habitat.



We Drove to

Cloud Jungles

The tropical highlands of Honduras provide a "post-graduate" tour for those hardy motorists who believe any trip is possible if you plan it right

By LORUS J. and MARGERY MILNE*

Photographs by the authors

IN the American tropics there are many kinds of jungles. Each may have its own orchids and poisonous snakes, its ferns, birds, and butterflies. In Panama we had explored those at *low* elevations—the real rain forests. But since it was then Wet Season and we had no automobile, the *high* jungles called unheeded.

Latin America taught us to trust to the future. Tomorrow—*mañana*—was always the day when wishes came true. So we hoped for a *mañana* when we could return to the tropics to see the remarkable extremes attained by vegetation on a cloud-capped mountaintop. We longed to search through a "cloud jungle" for the Central American symbol of freedom—that vanishing bird of flaming feathers, the quetzal.

Two years later, *mañana* arrived!

This time we chose Dry Season, when roads would be most passable; and we took our automobile to serve as a base for field trips. It would tote our heavy camera gear and collecting materials whenever and wherever we wanted—as long as there were roads. With our own vehicle we could stop and camp in each region that appealed to us and extend our studies through every hour of the day.

Cloud jungles dot the five little countries linked to each other by the Pan-American Highway be-





▲ DR. WILSON POPEHOE outside his home in Zamorano, holding the flag of the Explorers Club with Lorus J. Milne. Behind is the flame vine, whose orange blossoms flicker like fire.

tween Mexico and Panama. Maps showed that roads of a sort had been built close to many of the mountain-peak islands we sought. We should be able to climb through the seas of mist to them, high above the volcanic lands of Central America.

Reaching the area by car is not simple, since these countries lack road connections with the rest of the Americas. To take an automobile there, if the traveler does not want to endure a flatcar trip through Mexico, he must either land precariously at one of several small Pacific ports or make use of railways in Guatemala, Honduras, or Costa Rica. The shortest of these rail rides is from Puerto Cortés, Honduras. We chose it as the most direct route to our destination.

Three weeks after the dry season officially began in Honduras, we took the banana route across the Caribbean and landed at Puerto Cortés—or rather muddled down. The books had told us there would be clear skies, perhaps a little dust, but certainly no mud. Instead, our arrival coincided with the height of

a tropical storm that had assailed the Honduran coast for three days. The gangplank ended in a great puddle, maintained by a warm shower bath extending as far as we could see.

Soon we were sitting as sole passengers in the front car of a special eight-wheel train. Our chariot was a Ford jitney, whose steel wheels fitted the rails. Alternately we stared past the clicking windshield wipers at the gleaming track ahead and through the rain-streaked windows in the flapping side panels. The scene was a seemingly endless procession of banana plantations which the railroad served. Behind us tagged the swaying flatcar on which our own station wagon danced a well-sprung ballet.

At intervals, the two-car private train—jitney and loaded trailer—stopped so the driver could check by trackside telephone to make sure the road ahead was clear of freight. Once he paused at our request to let us get a steadier view of a dozen pink birds standing motionless in a marshy lake.

"*Herones rosas*," he told us. We

*Drs. LORUS and MARGERY MILNE began their popular nature writing in *NATURAL HISTORY*. Two years later (1947), another piece in this Magazine won them a George Westinghouse Science Writing Award, and their first book appeared (*A Multitude of Living Things*). Since then they have written numerous nature articles and sev-

eral books—*Famous Naturalists*, *The Biotic World and Man*, *The Mating Instinct*, and a research monograph on eyes in invertebrate animals. Their latest book, *The World of Night*, to be published this month by Harper & Bros., is a fascinating drama of nature based on their explorations in North and Central America.—Ed.



▲ ALONG THE CARIBBEAN COAST, where the traveler disembarks with his car for inland explorations, the spiny lobster is a delicacy much sought after. It lacks the two large claws. The lobster's "feelers" are so strong that it can be held by them.



◀ ONCE AN ACTIVE SILVER MINING CENTER, the little town of San Antonio del Oriente now learns scientific farming from the Pan-American Agricultural School in the valley below.

▲ HIGH ON MOUNT U passionflowers spread rich designs. Their ripe yields a refreshing

▼ ALONG THE SHORES OF THE CHOLUTECA RIVER, six-foot iguanas clambered over the jungle trees, feeding on insects and fruit. If disturbed, they would drop to the ground and scurry off, or plunge into the river and stay submerged for fifteen minutes or more.



were sure they were flamingos—the first wild ones we had ever seen.

It was still pouring when we reached the end of the line. It seemed incredible that we had come only 40-some miles inland. But we had traveled the length of the narrow-gauge railroad that forms the only link between the Atlantic port and any road that could get us to the Pan-American Highway. The transfer point was Potrerillos—a collection of unpainted wooden huts on stilts, and the railway dead end in every way.

The driver and his assistant attached ramp boards to the trailer platform, and we backed our station wagon down to the muddy street. They pointed the way to the "Interocean Highway" and waved goodbye. The population of Potrerillos watched silently from their dripping verandas as we started.

None of them could possibly have realized how alone we felt. With a smattering of Spanish picked up in Panama and a full gas tank (plus two five-gallon supplements hidden away among the cartons of canned groceries), we were on our own.

Out of Potrerillos, the InterOcean Highway improved into a potholed, washboardy ribbon of mud that wound through still more banana farms. Twenty miles per hour seemed a reasonable speed for



FOUR-EYED FISH, swimming in formation at the surface of the Choluteca River. The parts of their eyes visible above the water are able to see above the water. Simultaneously, they can observe what is going on beneath the surface.



▲ IN FLAMING CONTRAST TO THE JUNGLE FOLIAGE, scarlet macaws fly rapidly in pairs and dive abruptly into the trees to preen themselves.

comfort and safety, and we held this until the road started to climb.

Rising slopes were less slippery, and all grades proved reasonable. Except for truckloads of timber heading for Potrerillos, we had the road to ourselves. Nevertheless, we drove gingerly. For the first time in our lives, automobile insurance had

deserted us. None was available for these parts.

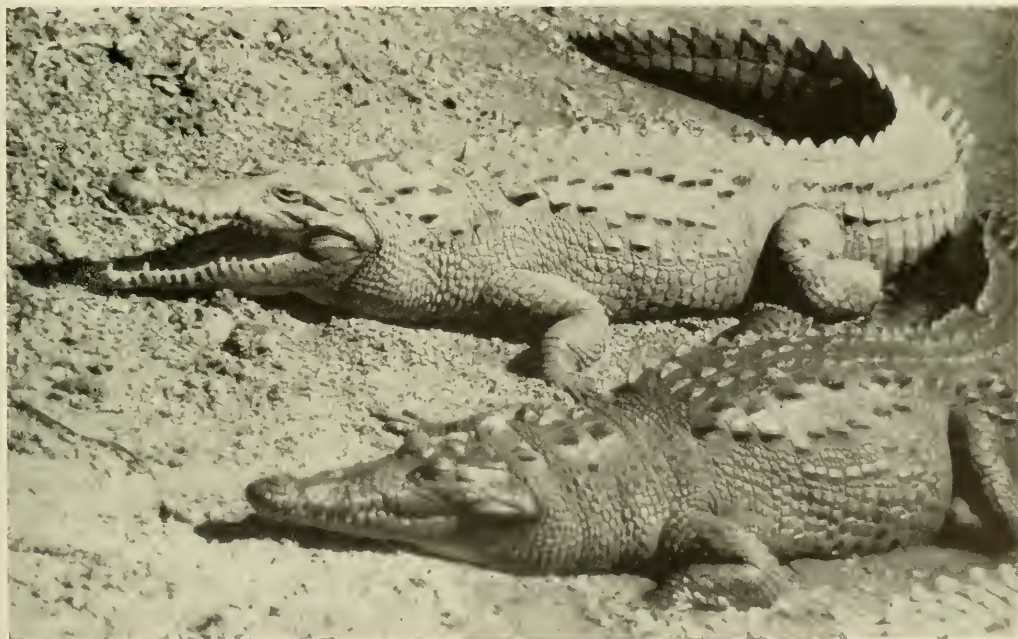
In place of the rear seats in our four-door station wagon, we had built a wooden platform supporting air mattresses and a full double bed. Below the bed were compartments containing collecting and camera gear, food, a gasoline stove,

medical supplies, a sixth wheel with tire, and other emergency equipment.

The highest part of the Inter-ocean Highway comes about 80 miles from Potrerillos. Thereafter only a dense haze and overcast represented the coastal storm.

We descended to the first town

▼ CROCODILES bask in the sun along the riverbanks near the Atlantic and the Pacific coasts of Central America.



where gasoline could be bought—Signatepeque—and thence into desert country! There were tree-sized prickly pear cactus and other arid-land vegetation. Beyond were switchbacks that made the twisty roads of Virginia or western Colorado look straight. They led up the next major range and into open pinelands again. Many of the fine trees were draped with Spanish moss, and they also supported air plants (*Tillandsia* and other bromeliads), showing how regularly the mists sweep down upon them.

Road signs were lacking, and in the former Honduran capital, Comayagua, we got lost. There were only two "good" roads—the one by which we had entered and the one on which we wanted to leave—but it was quite a time before we found the route again.

As five o'clock approached, headlights became necessary under the overcast sky. We snailed along the unfamiliar, twisting road and wished it had curve signs or barriers rimming the precipitous drops on the down-mountain side. Eventually the lights of the twin cities—Comayagüela and the present capital, Tegucigalpa—showed far below us. Since stores lack show windows down there and most homes are dark, only the high-hung street lamps at intersections showed us the pattern of the streets far below. The city looked like a wrinkled carpet studded with fireflies. We descended by switchbacks.

Welcome to Tegucigalpa!

On the boat we had been told that we could park safely in the walled grounds of the United Fruit Company office in Tegucigalpa. Accordingly, we stopped at the first policeman in town and asked directions. A crowd of at least 100 people collected around us. Mispronounced translations of "United Fruit Company," "Banana Company," and the like meant nothing to anyone. We tried the name of the railroad—run by United Fruit—and instantly were directed back to Potrerillos! Finally we rearranged the question, asking for the office

of the Tela Company—instead of the Tela Railroad Company. Faces brightened in the dark. *La Tela* everyone knew. A boy guided us the few blocks to the gate in the high wall behind the office, and in we went.

The next day we continued toward the east, over more mountains, to the village of Zamorano, 23 miles distant. Eagerly we approached the fine buildings of the *Escuela Agrícola Panamericana*—an agricultural college at which Latin American boys study on all-expense scholarships, learning how to get better crops from the reluctant soil.

As we pulled up in front of the main building, a white-haired gentleman strode briskly to us.

"I'm Wilson Popenoe," he stated. "You must be the Milnes."

Dr. Popenoe has directed the school since it was opened in 1943. Before that, he had spent ten years with the distinguished Dr. David Fairchild, exploring for useful plants throughout Latin America for the United States Department of Agriculture. Later Dr. Popenoe had acquired an enviable reputation in tropical horticulture during nearly 20 years with the United Fruit Company. If any man could check over our proposed itinerary and make helpful suggestions as to where to go and whom to see, Wilson Popenoe was the one. Few have such firsthand knowledge of the relation between Latin Americans and the land they live on, the plants and animals that surround them.

We admired the flame vine clamoring over the front and roof of his home, and Dr. "Pop" pointed out how the climber got its scientific name. In the slight breeze, the partly detached flowers of the previous day quiver like an orange flame, so it was named *Pyrostegia*, literally "covered with fire." Hondurans call the plant "San Carlos Flower," however, and the origin of this remains a mystery.

It was our good fortune that Dr. "Pop's" son, Hugh, was home on leave from a tour of duty in the Army. Hugh had grown up in



▲ SAN JUANCITO, most active mining center in Honduras today.

Zamorano and was able to guide us to a variety of interesting spots beyond the valley famlands. The precipitous road that took us to the former mining town of San Antonio could be negotiated only by jeep. Its hairpin turns exactly matched the jeep's sharp turning radius, and the surface was like a rocky creek bed.

Four-eyed Fish

Our station wagon traveled more comfortably to other localities—even with four in the front seat. One of these side trips stands out as a high point of delight. In the Choluteca River, we found the almost legendary four-eyed fish, *Anableps*, swimming in flotillas and skipping over the water. They were sometimes visible as much as 100 yards away, for their eyes—like a pair of glistening white bubbles—produced a V-shaped wake as the fish skimmed along the surface.

The largest ones were about ten inches long and swam alone, but the smaller ones grouped themselves and worked the stream in formations of surprising constancy. Whether two or a dozen formed a cluster, they acted as a unit, keeping speed, direction, and distances uniform in spite of ripples or sudden changes in route. As the four-eyed fish cruises along like a surfaced submarine, the upper pupil in each eye looks into air and per-



▲ BABY PARROTS in pinfeathers snooze much of the day, waking chiefly when their parents bring food.

mits the fish a binocular field upward and forward. At the same time, the lower pupil faces into water and gives the fish a binocular view directly downward and ahead.

What the fish could see through the muddy stream continues to puzzle us. Yet if they were pursued by several wading people, they would dive and escape. When a long-handled butterfly net was brought near them, they raced away over the surface and threw themselves clear out of the water by repeated powerful thrusts of the tail. So excellent is their vision into air that the only easy way to catch a four-eyed fish is to fire a .22 rifle into the water in the middle of a flotilla and reach quickly for a specimen or two while the shock of concussion still stuns them.

An even greater satisfaction in the Zamorano region was to enter the "weeping woods"—the cloud jungle—atop near-by Mount Uyuca. Here, in innagination, we stepped into the forests of the Carboniferous era. Uyuca's 6300-foot peak forms a realm apart—*la montaña llorona*, which is Spanish for "weeping woods" and is a perfect name.

To reach the weeping woods from Zamorano, we followed the road toward Tegucigalpa. Near the crest of the first big rise, we parked the car and climbed on foot through the hot, bright morning sun into open pine woods—the



▲ A RAINBOW-BILLED TOUCAN, with sulphur-yellow chest. These birds yelp to one another and posture to show off the colors of their gaudy beaks.

ocotal, named for the ocote pine (*Pinus oocarpa*). Higher up, a different conifer, the pinabete pine (*Pinus pseudostrubus*), is typical, and this is therefore called the pinabetal zone.

Among the epiphyte-laden limbs, large black hummingbirds danced in the mist like tiny toys on invisible strings. Above this, in a saddle, were patches of farmland with vineyards of passionflowers, from whose fruit a refreshing juice can be squeezed. Calla lilies and single carnations were grown at this elevation for the Saturday market in the capital. Northern plants, such as blackberries, Indian paintbrush, and bracken, also grew well here.

Suddenly the iridescent tropical hummingbirds and the sun were gone. We stood astonished in a tangle of great trees, all unknown to us. The air was fully ten degrees cooler and filled with the mixed fragrances of wet plants and soaked soil. Every surface, whether branch or liana or root, was crusted with a rich coating of mosses, ferns, orchids, algae, liverworts, and bromeliads. The whole tropical plant kingdom seemed crowded onto this one mountaintop.

For many hours out of each twenty-four, a cloud surrounds the summit and fills the high aisles between the trees with fog. Silhouettes that would be sharp and clean take on a ghostly outline. And myriads of plants, instead of using roots, depend upon the water-saturated air. So well does this way of life serve their needs that the real trees are hidden, loaded with tons of vegetable squatters.

Curiously enough, the cloud forest seemed empty of animals. Amid this profusion of edible foliage we found only a few spiders and a single bee; we heard no mammal, bird, or frog. Tracks showed where wild pigs (peccaries) had rooted during the night. The silence seemed uncanny, and we fell to contrasting this tropical Eden with the open pinelands and deserts nearer the Caribbean. In the latter, the diametrically opposite sort of vegetation grew. Arid-

land leaves curled in leathery toughness, seizing every molecule of water that came their way. Or leaves would be missing altogether during much of the year, leaving spiny branches that would repel foraging animals. Yet more creatures were abroad among that harsh and prickly vegetation than followed the rare trails through this cloud forest. For every snail on the wet flanks of the mountain, there were a dozen lizards on the dry soil. For every termite in the wet woods, a thousand ants swarmed over the stony ground among the cactus trees.

Mount Uyuca is a gem of cloud jungle. Its lower slopes are closely set with *milpas*—those “wallpaper cornfields” that slant so steeply up the eroding mountainside. A far larger example of weeping woodlands crosses the precipitous road northeast of Tegucigalpa, on the way toward the Rosario silver mine at San Juancito. Here the land reaches a plateau at an elevation about 7500 feet. For some reason peccaries do not seem to penetrate the jungle here, and possibly, as a result, this area is home to a variety of animals absent entirely on Uyuca.

Land crabs—strangely out of place so high above the sea—scamper out of the cloud jungle onto the road. The fringing trees hold little flocks of toucanets—small toucans that are raucous-voiced yet sociable. And over the soaked, encrusted soil creeps the short, thick, deadly viper known as the *tamagás*—a camouflaged relative of the bushmaster and fer-de-lance.

Twice we made the trip to the San Juancito Mountains to visit this larger cloud jungle. The first time, we drove our loaded car until the road grew so steep that we stopped dead still with the motor racing in low gear. On that trip we

parked on the slope and walked to the top, arriving breathless and perspiring just in time to see a flash of green fire trailing behind a rose-breasted bird that sparkled like a jewel as it streaked across the road. It was a male quetzal—most resplendent of the trogons—flirting his yard-long tail as he raced before us to vanish into the jungle.

The Plumed Serpent God

The steep road had led us into the haunts of history. Here was the quetzal—the symbol of wild freedom—and here the lurking viper, agent of death. Ages before, the Mayans had known these two. They had built a new civilization in Central America based on corn and black beans and had then declined. They linked the glory of this bird with the terror of the snake in visualizing their plumed serpent god, which the Aztecs later worshipped as *Quetzalcoatl*.

Regretfully we left Tegucigalpa



➤ THIS YOUNG COATI, caught in the jungle, resented being held but otherwise was as playful as a kitten.



▲ FLYING OVERHEAD, the king vulture needs a good ornithologist to distinguish it from the commoner black vulture. But on the ground, its red neck, white eyes, and orange wattle and collar make its countenance difficult to forget.

and headed south toward the Pan-American Highway, still wishing we could return to the San Juancito cloud jungle, to penetrate again into its stillness. Only our time schedule stood in the way. Instead we admired the new roadwork where the Hondurans were improving the Interocean Highway.

As we approached the scene of actual construction, the crushed and uncrushed rock grew coarser. Heavy trucks had left ruts so deep that steering became impossible. The bottom of the station wagon rumbled ominously against the road. The ruts swerved to the right, and a sign—a large wooden arrow—pointed for us to follow the turn. Worse and worse grew the way. The work crews hove in sight. They saw us and waved us back.

But the arrow?

That was for the work trucks! We should have turned left there,

to a narrow trail about as impressive as a farm lane in the hills at home.

Back we went. But before we reached the "intersection," our motor coughed and died. We jumped out and saw that the continual pounding of the rocks had hammered our full gasoline tank backward until the metal hose line no longer connected it to the motor. Our precious fuel, at 50 cents a gallon, was pouring onto the road!

Shattering fingernails as we burrowed under the car, we hauled out rocks faster than a frightened armadillo. One of us jammed a wad of leaves into the spurting tank while the other opened the emergency repair kit and invented a way to bridge the gap and hold the line to the tank well enough to get the motor started. We limped back to the capital and made it with only a few gallons to spare.

At the office of *La Tela*, we asked where we could find a good mechanic. The staff was most sympathetic and arranged for a skilled man to start work immediately. He must empty, remove, weld, and replace the torn tank. We knew better than to ask how long it would take!

With our car crippled, our expedition reached a standstill. We would have to wait while the repair job progressed at its own pace. Ruefully we reminded each other of a new word Latin America had taught us — *paciencia* ("patience"). Somehow it seemed more hopeful than *mañana*.

But we had underestimated the helpful people of the Tela Company. They wanted to do something for us. How would we like to use our extra day?

We mentioned the cloud forest on the way to San Juancito as the



◀ THE RADIO AERIAL on the authors' car provided an unfamiliar perch for this red-capped parrot.

descending toward the town, the headlights picked out a road sign that meant business: a skull and crossbones, plus three little crosses and the words "3 MUERTOS"—"3 DEATHS."

We stopped the driver from going on and asked him to park where the road was wider, while we explored ahead on foot.

Suddenly the fog brightened. The cloud lifted, broke, and swept away. Sun poured down on the wet roofs of the Rosario mine. Far beyond, the Choluteca River twisted across the valley floor.

With clear sky and sunlight came the fluid pipings of an inconspicuous gray Nightingale-thrush, known locally as a *jilguero*. At intervals we heard the ventriloquial call of a black robin (*sincoutle*), with white eyes and a yellow beak. Sweeter sounds than these are rarely heard.

The driver sat in the truck, uncomprehending. We followed remaining wisps of mist through the weeping woods, searching among the moist foliage for another quetzal as though it were the end of a green-blue rainbow. Time and again we glimpsed these shy birds among the shadows. Occasionally they flitted out into the pale green filtered light of a jungle corridor to

perform an acrobatic stunt in mid-air and then hastened back to their perch. At each encounter we held our breath, hoping that a bird would fly close. Gradually we learned that the male bird, with his soft rose-colored breast and unbelievable length of slender tail, could be identified if only his head showed. His bill is lemon yellow, whereas that of his mate is black. Her tail is short, not much longer than the tips of her wings at rest; and the only red visible on her underparts is well back, behind a front of chocolate brown.

The weeping woods and this type of trogon go together all the way from Mexico's southernmost state of Chiapas to the Panamanian province of Chiriquí. They bracket the five little countries we explored by car and give them a common bond of kinship. One, Guatemala, has adopted the quetzal as its national emblem and as the name of its unit of currency. But Guatemala, like El Salvador, has few quetzals left. The spread of agriculture up the peaks may eliminate these birds from the other countries, too. For only so long as there are cloud jungles large enough to make quetzals feel at home, will these magnificent fliers continue as living symbols of Central America. Their presence is not so much a sign of freedom as a proof of the existence of unspoiled land and unexploited peaks.

spot we longed most to revisit. By radio-telephone they called the Rosario mine in San Juancito and asked about the weather conditions. All was cloudy above the mine. They warned us that it might rain at any moment and that such a trip on so poor a day might be fruitless. We reminded them that it was the dry season and *couldn't* rain. This brought grins all around, for it had poured the day before.

So off they packed us in a pickup truck, with driver and lunch. Up the mountain we ground in lowest gear. Past the slope where automatic drive had failed us. To the top and over the crest—in thick fog. Then, as the switchbacks began

➤ THE MOST DANGEROUS OF CENTRAL AMERICAN ANIMALS are the peccaries, wild pigs that travel in packs. They may charge, gnashing their razor-sharp teeth.



Paintings on Cobwebs

continued from page 207

bought all he had on hand but commissioned many more to be delivered to Vienna.

Not a single signed picture by Elias Prunner has been discovered so far. The four unsigned cobweb pictures that I found in the curio collection of the Castle Ambras may very well be the ones that Maria Theresa bought from Elias Prunner, since she owned the castle and might easily have added them to its collection.

This Castle Ambras, in the vicinity of Innsbruck, knew its glorious days in the sixteenth century, when it was owned by the Archduke Ferdinand of Tyrol. For his beloved commoner wife Philippine Welser, whom he married in secrecy against the will of his father, he had the medieval castle rebuilt in a grandiose manner. He filled it with art objects, books, and armor; and his "*Kunst und Wunderkammer*," a "collection of all things rare and not generally seen," attracted visitors from all over the world. This curio collection later received occasional additions, and in the eighteenth century it was known to have some cobweb pictures. The castle's captain Johann Primisser writes in 1777, in his booklet "Brief Information about the Imperial Curio Cabinet at Ambras in Tyrol," that among pictures on various materials there are *even* pictures on spider web.

He may have had reference to the cobweb pictures of Johann Burgman, which are also in the Ambras collection. Johann Burgman, known as a pupil and follower of Elias Prunner, came also from the Puster Valley. He was born in St. Georgen, near Bruneck, and died there in 1825. Originally an unsuccessful church painter, he might have been forgotten had it not been for his cobweb pictures. Indeed, there are about 67 signed Burgman pictures in existence, and at least two of them are in the United States. In addition to religious subjects, he tried his hand

at landscapes, still-life studies, and portraits. Apparently at the height of his success in 1799, he made a charming brush drawing of the Emperor Leopold II with his family.

Another follower of Elias Prunner was one of his kin, Johann Georg Prunner from Dietenheim, near Bruneck. Unlike Burgman, he was a professional painter and engraver. Several of his works, the earliest dating from 1734, are known. Apparently challenged by the unusual medium his cousin Elias had mastered, he undertook to make a few *engravings* on cobweb, but only four are in existence. Only two of them are signed, but the other two seem also to be by his hand. One of these, made in the first half of the eighteenth century, seems to be the oldest cobweb picture known. It is a Madonna and Child on a crescent moon—a tiny engraving 4 inches tall and 2½ inches wide, surrounded by golden handmade lace.

Two more engravings on cobweb, each by a different artist, are all that exist of this unbelievable application of cobweb in the engraver's craft. Of these, the so-called Abgar portrait of Christ is quite exceptional in technique. It was engraved in the Puster Valley from a plate made in 1730 by a Swiss-born artist, Johann Heinrich Stoercklin, who died in 1737 in Augsburg. It is very possible that the actual printing was done either by Johann Georg Prunner or by Burgman, since both had experience in handling the fragile gossamer.

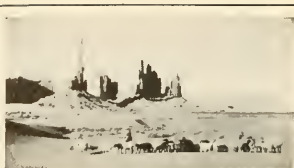
Several other artists from the Puster Valley and, to a limited extent, from Salzburg, tried their hand at cobweb pictures. Side by side with the naïve creations of the village craftsmen appear pictures that are quite artistically composed and executed. The artist very often followed examples of ecclesiastical and secular art that he happened to see, though he in-

terpreted them in his own manner.

Some of the pictures were just copies, as, for instance, the one in the Chester Cathedral in England, which is proudly described in the Cathedral's guide as "an exquisite little treasure in the chapel . . . a Madonna and Child, painted on fabric woven from a spider's web and preserved between glass. It was brought many years ago from Innsbruck, where lived a family knowing the secret of this remarkable work." This "treasure" is a miniature copy, probably by Burgman's hand, from the famous Maria-Hilf Madonna by Lucas Cranach the Elder, painted around 1537. This latter painting is one of the most beloved and often copied miraculous Madonnas in the Alps, and it has been treasured in the St. Jacob's parish church of Innsbruck since 1650.

With the death of Johann Burgman in 1825, the craft of cobweb painting vanished almost completely in the Puster Valley. However, in the 1870's, it was revived in the northern Tyrol, especially in Innsbruck, and was practiced there for a few decades. Through the efforts of two efficient art dealers, cobweb painting developed into a thriving industry catering particularly to tourists. Franz Unterberger and C. Czichna, both of Innsbruck, employed a staff of artists who followed the old traditional method of painting on cobweb in water colors. They still obtained the web from the Puster Valley where the craft originated. But instead of religious subjects, the pictures now displayed colorful Tyrolean scenes and landscapes. Miniature copies from the works of Franz von Defregger, the famous painter of Tyrolean peasant life, were particularly popular. The pictures were mounted on cardboard, decorated with a large drawing of a spider, and provided with a small sample of cobweb to emphasize the unusual fabric. They attracted attention as curiosities and were bought as souvenirs. Several of them are known to be in the United States.

Apparently there is something



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fascinating about these cobweb pic-
tures, because two more attempts
were made in our time to revive the
craft. In the late 1890's, a young girl
from Fayetteville, Tennessee, read
about it in a magazine and began
to experiment. It took her two
years of infinite effort to produce
her first picture, but as the years
went by, she became quite an ex-
pert. She used the webs of brown
grass spiders. Two of her pictures
are on display in the Smithsonian
Institution, in Washington, D. C.
And quite recently there also ap-
peared in an exhibition in Vienna
a series of tiny pictures on cobweb
by a contemporary Austrian artist,
Justinus Szodan, who devoted his
life to master this delicate art.

As it becomes better known,
others will no doubt attempt to
produce a painting on cobweb. For
those who may be thus challenged
by the ultimate in fragility, we may
say there is no difficulty in finding
the web of the brown grass spider
in fields and orchards in this
country. Search for it toward the
end of summer, when it will be
sufficiently dense to serve as a "can-

vas." The house spider in the attic
will also oblige if not menaced by
dustcloth or broom.

When you have secured the web,
stretch it on a cardboard frame
with an opening the size of the pic-
ture you want to paint. A second
piece of cardboard is placed under
the opening as a temporary sup-
port. If water colors are to be used,
first size the web with milk diluted
in water. For a more opaque effect,
mix the colors with some white. Oil
paint is just as good a medium if it
is thinned well with turpentine.
Apply only a small amount of paint
at a time in the form of dots, hatch-
ings, or stippling, and allow it to dry
well before going on. Use very fine
and soft brushes. A woodcock pin-
feather is a good substitute for an
expensive sable brush.

But most important of all: ac-
cumulate a large supply of patience
before starting, and, finally, beware
of making a mistake, since it is not
possible to correct the smallest
error. That, perhaps, is why this art
could originate only among people
in whom religious devotion was a
passion.



"Wait till I tell the girls about seeing that woman wearing
the same hat that Betty is passing off as a Paris original."

Letters

Snake Split

Sins:

We all know that snakes can and do swallow prey that is many times greater than their own diameter, but this one apparently paid for having "eyes bigger than its stomach."

This specimen of the Common Water Snake was 30 inches long and had captured a 10-inch trout. That the snake managed to swallow as much of the fish as it did is remarkable. But there is an elastic limit even to Water Snakes, and this greedy reptile seems actually to have split open, not only on one side but on both. Unfortunately I was not able to witness the actual demise of the snake.

FRANK R. SCHETTY

Hasbrouck Heights, N. J.

The following comments are offered by Richard G. Zweifel of the American Museum's Department of Reptiles and Amphibians:

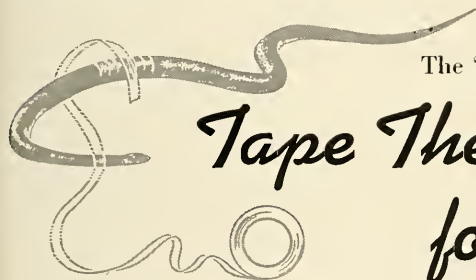
Persons unfamiliar with the capabilities



of snakes are invariably amazed to see a snake undertake to swallow an animal with a greater diameter than its own. Yet snakes do this quite commonly.

It is unfortunate that Mr. Schetty did not actually see this snake split. It seems unlikely that once having taken the fish down so far, with the bulk of the fish past

the narrow throat, the snake would have split without outside help. Someone might have encountered the much distended reptile, whose ability to escape would have been greatly impeded, and struck it, causing the tightly stretched skin to rupture. But the possibility that the snake split without help cannot be ruled out.



The "patient" seemed to know the hand that saved it

Tape Therapy for a Black Snake

By JACK M. MACDONALD

I LEARNED early in life that most snakes should not be killed, that they do much more good than harm. That's why I rescued a young black snake one afternoon from two boys who were stoning it in a roadside ditch near my home.

When I got there, the snake was pretty badly used up. There was a wide gash in its middle, a deep cut below its head, and one eye had been pushed almost from its socket by a well-aimed rock. I stopped the killing, explained that black snakes are "good" snakes which kill rats and other pests, and sent the boys on their way. I then brought the snake into my own back yard.

It was, or had been, a beauty—shining black and measuring about

three and a half feet in length. Each time it tried to move weakly, grayish muscles would bulge from its midsection, and the lower half of its body would turn at right angles to the rest of it. I knew it could neither move nor live that way.

I had never repaired a snake before, but I decided to try my hand at this one.

The bathroom cabinet in the house produced only short white adhesives. But in the top drawer of my desk I saw a roll of one-inch Scotch tape, and I decided to try that.

I first stretched the injured snake on the grass and pressed its eye gently back into the socket. I then worked on the neck cut, pushing

the wound together and taping it. I closed both wounds that way, pressing the edges together and running the tape around the body so that the tape ends didn't quite meet. I felt that the edges of the tape would scrape off more easily later if they were not "glued" together.

The procedure was easy, for the snake struggled very little. Only after I had finished did he make a sort of convulsive movement, turning over on his back with his lightish underparts to the sun.

The taping held as he turned, so I knew my operation had been a success. I was also sure my patient was dying, for I had never seen any snake turn over on its back.

Still hoping he might survive, I laid him in the cool grass under a spice bush and left him.

The next morning before going to work, I looked under the bush. The snake was there, looking beat-out but alive. Its harmless tongue moved out listlessly once or twice as I reached down. Then it lay quietly and seemingly unafraid as I stroked its back with my finger.

It was still under the bush that evening and had apparently moved little during the day. Again I touched its back with a slight stroking motion. Again it didn't seem alarmed at the touch.

The next morning when I stopped at the bush, the snake was gone. All day I wondered if it had crawled away under its own power or whether some dog or other

animal had destroyed it during the night.

That evening, after work, I went down to the spice bush. There was no sign of the snake. I stooped down to look more closely under the bush, when I heard a rustling in the leafy rows of beans in the near-by vegetable garden. I sat down on the grass and waited.

I wouldn't believe if it had not happened to me, but my patched-up snake came toward the spice bush from the bean rows. And I was sitting there in plain sight.

It stopped once to see, I guess, if I would make any movement. Then it came forward again, not too close but within reach of my hand.

I looked at my handiwork. The

Scotch tape was peeling a bit at the edges but still holding. The cuts beneath looked "sealed" together with some sort of secretion from the snake's body.

I reached down. The young black snake drew back its head, and its tongue slithered with old-time vigor. But it didn't move away. And, for the third time, I touched it lightly, much as you'd touch a pet dog.

When I moved to get on my feet, the snake also moved. This time, it slid along a short stretch of lawn toward an open field that adjoins our property. He moved easily now, body glistening in the sun. Leaving handicap and amateur surgeon behind, he was on his way to his own things.

I never saw him after that.

BOOKS *continued from page 175*

This book was first published in England in 1855, under the title *Fur Trappers*, but extensive revisions were made

at that time, since it was felt that Ross' style was too salty for mid-nineteenth century tastes. The present edition follows the original manuscript, now in the library of Yale University.

HARRY TSCHOPIK, JR.

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There are a few typographical errors, and some of the color plates of minerals could be clearer. Serpentine asbestos, for instance is not lavender but either light green or white. However, the great amount of useful and interesting information in this small handbook makes it a particularly desirable reference book for all young collectors of minerals or for anyone interested in an excellent introduction to rocks and minerals.

DAVID M. SEAMAN

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The little man apparently never dreams of questioning this system. To him, it is a perfectly satisfactory transaction. He eats the leg of pig, enjoys it, and is happy. The big Chief has shown a neat profit. To the European, this is all quite incomprehensible and smacks of sharp practice. But to the Mbowamb, it is legitimate and perfectly ethical.

All the people who are in some way dependent on the Chief must be remembered, too. There is his immediate family, which in a polygamous household can be considerable. There are also his serfs and the servants of his wives. These must all receive a just share of the pork. The task of dividing the meat therefore requires hours. The Chief has to cut up the meat or the pork himself, but his wives are much in evidence and keep a watchful eye on the proceedings. I even saw a wife grab her husband's hand and move the knife over so he would cut a larger piece. There were also some genuine family squabbles. The Chief may be the biggest man in his clan, but his wives can certainly tell him off. They have raised the pigs and don't hesitate to speak right out.

The sixth and final day of the Moka was a veritable madhouse. While the dancers were making the earth tremble, the big Chiefs who were making the Moka were busy putting the gold-lipped shells on display. The shells had been polished and rimmed with red clay. They were unpacked personally by each Chief. The red clay dust was removed, and the shells were polished once more.

Raglpa, the biggest of the Chiefs, put his shells out first. He had sixteen. The dancers stopped, and the multitude crowded around for a look. This was the supreme moment for the great man to flaunt his wealth. The shells were too precious to rest on the ground, so ferns were laid down to receive them, and great care was exercised in arranging them. A number of men cannot work simultaneously at this. That would hasten the process too much. The spectators must have an opportunity to gaze long and well.

After the first Chief had lined his shells, the next man put his down. The mob marveled at each shell as it was brought from its wrappings, and they moved along as the line grew in length. I counted 529 shells, but more were still coming. It is certain that over 600 gold-lipped shells changed hands in the Moka and at least half as many pigs.

After the shells extended the full length of the dancing ground, each man who was to receive some counted his share, either eight, ten, or sixteen.

When the shells had been counted, there was a slight delay while the donors went to smear their bodies with ashes. Then, with ferocious shouting and yelling, they charged up and down the line as fast as they could run, carrying axes, spears, and bows and arrows. The significance of this is twofold. The first thought was apparently to drive out the shells. They had given them away and didn't want them anymore. The second, and certainly the more important, was to give all the people a good look at

those who had given the Moka.

The new owners now gathered up the shells and packed them carefully away. They were only receiving what they had once given. The only increase was in their honor and glory.

But the men who had made the Moka weren't finished yet. Beginning with Raglpa, each one shouted at the top of his voice, telling all within earshot of what he had done. This self-praise finished the Moka. For six days, the ceremony had been the burning interest of several thousand people. Many of them had walked hours to attend. It was a great social event, and the preparations had taken many months. The raising of some of the pigs had even taken several years.

It should be remembered that these shells have all been traded along devious routes from the coast. Missionaries discovered two definite trade routes many years ago. One led from Papua north into the interior, and the other came from the north coast of New Guinea south into the interior. The shells are all said to have originated in the Torres Strait region between Australia and New Guinea. Until the coming of the white man, they were the equivalent of gold throughout the Central Highlands of New Guinea. Even today, 23 years after the discovery of the Wahgi Valley, they are still highly valued.

Several times, chiefs had come to me at the dancing ground and said, "This is the fashion we like. We married plenty of Marys [native women] who raised lots of pigs, and now we make Moka."



Since some of the sounds they make resemble rhythmic propeller noises and even echo-ranging "pings," the state of mind of a submarine commander detecting them with his listening gear may well be imagined. In several cases, torpedoes were readied, but instead of the expected foe, a few sporting whales or porpoises were seen where the sound originated.

That some whales can bellow like bulls when wounded or alarmed was known to naturalists even in the eighteenth century. But such vociferous exclamations are rare. The usual whale sounds may result from the sharp escape of breath through the blowhole, which sounds like a whistle, from the snapping of teeth or baleen, or from the rhythmic beating of the powerful fluke against the surface of the water, which sounds like a propeller.

The sound of the forcible release of air through the blowhole can be heard for great distances, and old-timers in the whaling industry claim they can identify different kinds of whales by the tone and volume of the whistlings.

Porpoises likewise produce whistling, and the white whale, or beluga, is particularly famous for its shrill blasts. Mariners have called these animals "sea canaries." One submarine commander reported that "The porpoise sounds like a fast, small-boat screw rather than a torpedo."

Whales may use sounds for echo-ranging in order to find out how deep they are. Porpoises, which are known to be quite intelligent creatures, may even be conversing with each other when the hydrophone records their whistling.

Among the most widespread noises in shallow coastal waters is the sharp crackling sound produced by snapping shrimp. Some mariners used to think they heard the sounds of shipworms eating through the hulls of their boats; actually they were listening to noisy near-by shrimp beds.

The crisp snapping sounds of these small crustaceans were long brushed aside as merely a biological oddity, but in the early years of World War II they were found to be such a cause of confusion in underwater warfare that they were thoroughly investigated by the University of California's Division of War Research.

The type of shrimp that makes these noises closely resembles the familiar shrimp seen in the market. The characteristic sound is produced by the sharp closing of the snapping claw, which is extremely large in comparison with the rest of the body. The reason for this peculiar snapping becomes readily apparent when a specimen is observed in action. As the claw is suddenly closed, a jetlike spurt of water is produced by means of a plunger arrangement in the claw. This helps to frighten off any creatures that might molest the shrimp.

The University of California investigators found the crackling sounds comparable to the "explosive noises produced by large quantities of dry twigs or the frying of fat." In a detailed report on these creatures, they stated: "The bedlam of crackling noise over a shrimp bed is never ending. The continuity of high magnitude sound caused by populations of these animals appears to have no counterpart in biological nature."

Although the natural history of

sonic marine animals is barely out of its swaddling clothes as a science, many practical applications have already been made, and still more are in the offing. Experts will be able to predict what underwater sounds can be expected in various areas at different seasons, and the operators of the Navy's listening devices can then swiftly screen out biological interference from more ominous noises.

It may well be a matter of life and death for a submarine commander to know the locations of large beds of snapping shrimp or areas where croakers gather to spawn. The noises these animals make can even drown out the sounds made by his own vessel, so that if he is prowling in enemy waters he may be able to evade detection by "losing himself" among the natural creatures.

Commercial possibilities are also intriguing. Hydrophones may in the future be carried by fishing vessels for the purpose of locating large schools of fishes. And it is not too farfetched to visualize a frantic captain playing records of mating calls to lure vast numbers of lovesick fish happily into his waiting nets.

We still need a great deal more information about the way the animals themselves make use of underwater sounds. Perhaps this will guide us to uses that are as yet unsuspected.



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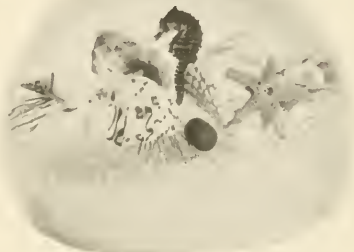
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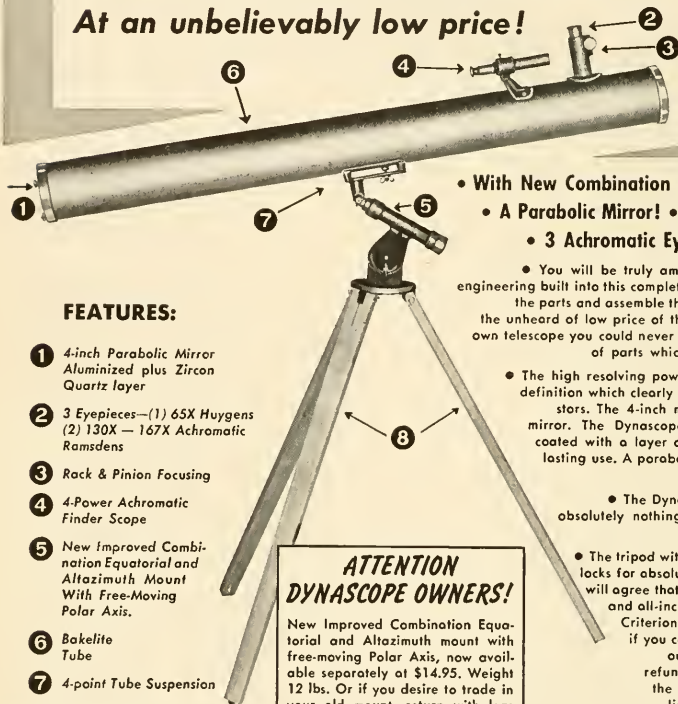
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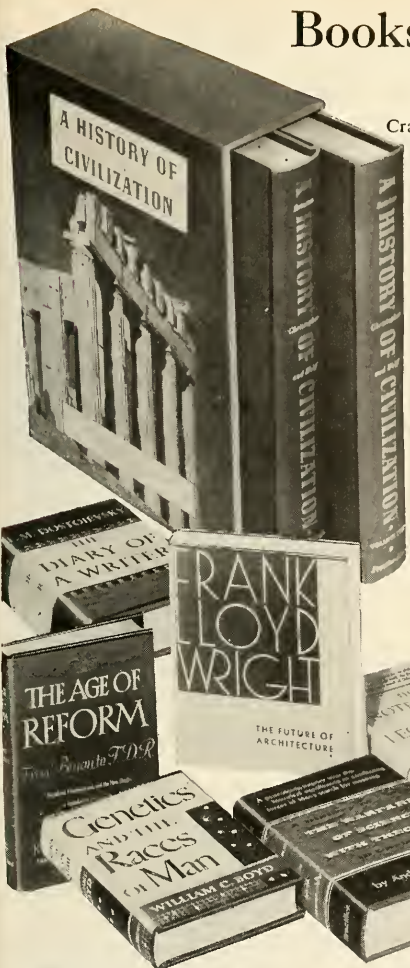
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May, 1956 Volume LXV, No. 5

Yellow-breasted Chat

From a color transparency by Mrs. Thase Daniel

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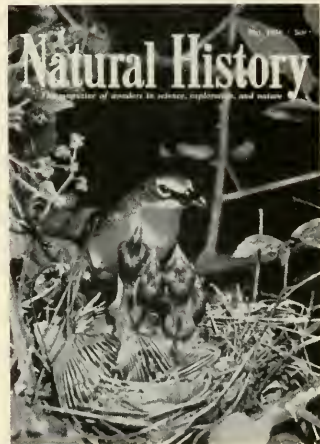
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THE COVER THIS MONTH

Its olive green upper parts and the vivid yellow of its throat and breast make the Yellow-breasted Chat a striking bird. It is the largest of our warblers and is found in the breeding season throughout the greater part of the United States. It migrates to Central America for the winter. The Yellow-breasted Chat nests in very dense thickets and briery tangles from one to five feet from the ground. The nest contains from three to five creamy-white eggs speckled with brown.

The bird in this color transparency, living up to its reputation for being very shy and elusive, hid in trees above the blackberry thicket where the nest was well concealed. While Mrs. Thase Daniel maneuvered to take the picture, a medley of gurgles, whistles, chatters, and squawks bubbled from its throat, unlike the song of any other bird; and while giving this eccentric song, it kept flapping its wings up and down and pumping its tail. No wonder the Yellow-breasted Chat is known as the clown among birds.

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THE NAVAJOS

----- by Ruth M. Underhill

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299 pp., 24 photos, 2 maps.

AT the present time the Navajo Indians are the most numerous tribal group within the United States. Seventy-five thousand of them live scattered throughout the canyons and deserts of northern Arizona and New Mexico, and in southeastern Utah. Of all Indians these seminomadic shepherds are, perhaps, the best known to the general public, and many people are familiar with their woven woolen rugs and their silver and turquoise jewelry.

It seems almost incredible, then, that six or seven hundred years ago there were no Navajos—at least by that name—nor were there any Indians then alive that lived like the Navajos of today. The Navajos as we know them are a hybrid group, racially and culturally, the product of a long and complicated history.

In order to tell the story of the Navajo people the author has tapped the sources of archeology, history, ethnology, mythology, linguistics, and U.S. Government archives, in addition to her own personal experiences and observations. She traces the migrations of the savage, half-naked hunters who were the ancestral Navajos from their original homeland in western Canada to the southwest, where they may have arrived as early as the twelfth century A. D. Once they were established in the Southwest, she shows step by step how their way of life was altered by contact with the village-dwelling Pueblo Indian farmers, the Spanish conquerors and settlers, the Mexicans, and finally the white Americans.

Navajo history has all of the ingredients of an epic. From an insignificant band of primitive nomads, the Navajos increased in power to become the lords of the land, a tribe of handbills feared throughout the Southwest. After a clash with American troops under Kit Carson, the Navajos were rounded up and imprisoned for almost four years. Once released, their sheep and horses gone, they were put on reservations as poverty-stricken wards of the Government. Gradually the Navajos made a comeback. Today, guided by their own veterans of World War II, and assisted by an enlightened administration of Indian affairs, they stand on the threshold of Twentieth Century world culture, determined to become a responsible and independent people.

This is a brilliant book of the highest scholarship, but it is much more than merely a study in history. Dr. Underhill's unusual literary ability has imparted to the narrative all of the dramatic impact and excitement of a first-rate historical novel.

—HARRY TSCHOPIK, JR.

BIRTHPLACE OF THE WINDS

----- by Ted Bank, II

Thomas Y. Crowell Co., \$4.50;

273 pp., illus.

THEODORE P. BANK, II, "Executive Director of the Institute for Regional Explorations and Leader of the University of Michigan Aleutian Expeditions" has a talent for adventure. This is a well written and amusing account of how a young graduate student of botany organized himself and a companion into a scientific expedition, and proceeded to Fort Richardson at Anchorage, Alaska. There they talked the commanding general of the Alaskan Department into providing them with transportation for a summer in the Aleutians.

Bank and his expedition first explored Adak Island, enduring the rigors of that wet and windy climate during the day and returning at night to a double quonset hut with oil heater. Botanical collections were made, and the high point of this work was the rescue of a military companion who had slid down a cliff on the flanks of Mount Moffit. With personnel of the Alaska Department Combat School, your reviewer spent a number of weeks walking around Adak, carrying shelter, bed, and a supply of food to last for a week at a time and so can appreciate what the expedition was up against.

After two weeks, the expedition moved to Atka via Navy PBY. Only a fast grab at the seat of his pants saved Bank from falling through an open observation port while photographing the volcano of Gareloi. At Atka, the two men of the expedition were the unexpected guests of a group of Harvard University research workers, mostly graduate students, who were engaged in making systematic studies of the language, culture, and physical characteristics of the few Aleuts living in the village of Atka.

After eleven days of botanical collecting and ethnographic studies, the leader of the Michigan Expedition was offered an opportunity by a Coast Guard cutter to return to Adak. There he was given

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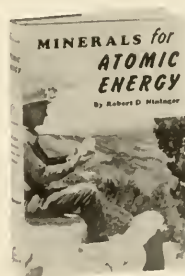
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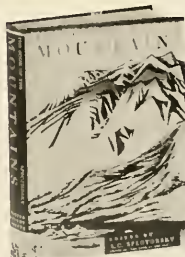
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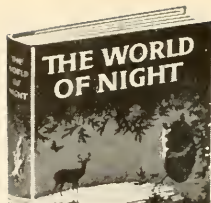
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the use of an Army power barge and crew for—as a crew member put it—"mummy huntin'." The skipper of the barge evidently was not accustomed to Aleutian waters, and Bank had to get the ship out of difficulty twice, both times in very bad storms. The last hundred pages recount the exciting adventures experienced while searching for mummy caves, most of which had already been rifled by Dr. Ales Hrdlicka of the Smithsonian Institution. Skills that almost foundered on barely possible rocky beaches and slabs of rock that fell from cave roofs during earthquakes served to make this work interesting. An enforced night in a mummy cave lent a tang of adventure. In the past ten years, considerable patient and tedious stratigraphic excavation in old Aleut refuse heaps has outlined 4000 years of the prehistory of these people, but the Michigan group apparently was too busy to contribute to this phase of archaeological research.

A few years ago, Bank was kind enough to provide the writer with a copy of his official report submitted to the Office of Naval Research. This had been down-classified from "Confidential" to merely "Restricted." This voluminous report in greater part parallels "Birthplace of the Winds" in that many of the incidents are described in almost identical words. More classified documents should be in this style. I would hesitate to recommend "Birthplace of the Winds" as an account of scientific fieldwork, but it is a good adventure story.

JAMES A. FORD

THE SINGING WILDERNESS

by Sigurd F. Olson;

Illustrated by Francis Lee Jaques

Alfred A. Knopf, New York, 1956.

\$4.00, 245 pp., 38 illus.

THIS is a series of essays dealing with the inspirational values of the wilderness. These impress the individual in various ways depending on his reactions to sight, sound, smell, or over-all awareness. The subject is treated on a seasonal basis, with chapters drawing upon the author's experiences and describing how he was moved by a wilderness which sang to him. Most of the incidents take place in the Quetico-Superior country, and an attractive map at the beginning orients the reader.

The most obvious appreciation of the wilderness is through sight, and few are the outdoor people who do not feel a quickening of spirit upon beholding unspoiled primeval forest, lake, and stream. In most of these experiences, the pleasure and the inspiration derive from the immediate view, and mental associations need play no great part. The wilderness impact

upon the ear probes deeper into memories and usually adds, through association, to the pleasure of the moment; and the more primitive sense of smell may owe even more of its attraction to the associations it recalls. Finally, there is an uplift and a general sensation of well-being that comes through a mingling of all impressions, and the man experiencing it does not try to justify it by any single sensation.

The author has led a vigorous life in the wilderness and found so many satisfactions in so many ways that they are not to be enumerated in a brief review. The reader should follow a leisurely course through this book and digest only a few chapters at a sitting. This is advisable not only to allow the impressions to sink in but to avoid a feeling of surfeit if the book is gulped down.

The beautiful pen and ink sketches of Jaques have caught the spirit of the wilderness and have dramatic appeal.

HAROLD E. ANTHONY

THE ART OF FALCONRY

by Frederick II of Hohenstaufen

Translated and edited by Casey A. Wood and F. Marjorie Fyfe.

Charles T. Branford Company, \$20.00
637 pp., 168 illus.

FALCONRY was a popular pastime with the people of China, ancient India, Assyria, and the provinces of Babylonia, Egypt, and Persia, thousands of years before the Crusades. It reached its climax in the West during the Middle Ages. The people were more than just fond of hawking—they had an absorbing passion for the sport and prized their hawks above all other possessions.

Frederick II of Hohenstaufen (1194-1250), Holy Roman Emperor, King of Sicily and Jerusalem, was the most brilliant exponent of the art of falconry up

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to that time. He was so fond of the sport that he even failed in several military expeditions because he took crucial time off to go hawking.

This book is much more than a manual of practical instruction on falconry; it is a source of interest to the zoologist and of value to those interested in medieval art and literature. It is, perhaps, the first work of its kind written in a critical, scientific manner; no attempt is made to glorify the sport or to fire the imagination with thrilling experiences.

The whole fascinating story of falconry as practiced in medieval times is here presented in detail, from the capture of the wild falcon to the time it is launched free but obedient to its master's will. This one volume actually comprises the complete six books of Frederick's treatise, which was based primarily on his own experiences and observations.

The first book is an account of the structure of birds, and their habits, in general. Book Two deals with the different kinds of falcons used in hunting, their equipment, care, and training (taming). In Book Three we come to the training of the falcon, its education, including the flying at game, and the hounds used in falconry. Book Four gives the student the rudiments of crane hawking with gyrfalcons, and in Book Five we learn about heron hawking with the saker falcon. Book Six is devoted to the procedure followed in hunting ducks and other water fowl with the peregrine.

The book includes a roster of birds, an extensive bibliography, a glossary, and an index. Numerous illustrations are presented with artistic appreciation and accuracy.

GEORGE G. GOODWIN

THE HOPI INDIANS: THEIR HISTORY AND THEIR CULTURE

----- by Harry C. James

Illustrated by Don Perceval
The Caxton Printers, Ltd., \$5.00
236 pp., 64 photos,
numerous line drawings, 2 maps.

THE HOPI INDIANS inhabit three rocky, arid mesas on the fringe of the Painted Desert in northeastern Arizona. One of their villages, Oraibi, has been occupied continuously since at least 1150 A. D. and has the distinction of being the oldest town in the United States.

Although the Hopi were visited as early as 1540 by Don Pedro de Tovar, who accompanied Coronado on his quest for the fabled seven cities of Cibola, these Indians had surprisingly little intensive contact with white men prior to the mid-nineteenth century. Before roads were built, their homeland was remote and in-

accessible, and there was no gold or other loot to lure the Spanish conquerors. The Hopi, moreover, proved to be remarkably tenacious of their native culture—particularly their complex religion—and they either killed or evicted the missionaries sent among them.

When scientists and writers "rediscovered" the Southwest around the turn of the century, the Hopi thus represented a glamorous and largely unspoiled American Indian tribe that attracted immediate attention. Much has been written about them, but owing to the complexity of their ceremonialism and their culture generally, the Hopi way of life has been described piecemeal, and most of the descriptive accounts are buried in technical publications.

Mr. James has done a fine job of simplifying complicated material without distorting it out of all reason. His warmly sympathetic picture of the Hopi is based on years of personal experience among them, plus a sound grasp of the historical and ethnological literature. The greatest omission, it seems to me, is the lack of a bibliography to guide the interested reader to additional sources on this most colorful group. The photographs are somewhat disappointing, but the line drawings by Don Perceval, many of them done in the style of mural paintings from abandoned Hopi villages, are very striking indeed.

HARRY TSCHOPIK, JR.

NATURE'S WONDERS

----- Edited and compiled by

Charles L. Sherman

Hanover House, \$7.50
252 pp., 462 illus. in color

THIS is a compilation of text and pictures brought together from many sources. Many of the pictures are recognized as having been published elsewhere. Because of the coverage in subject matter by various authors, who may have written independently of each other, there is a looseness of organization. Sound and authoritative specialists have worked on the text, but the selection of illustrations leaves much to be desired, and the work of the engraver is often inferior. The color values are poor and the captions often lack point or are even in error. One may be justified in wondering if the authors cited in the preface and the introduction wrote or approved of the captions. But the book will have eye appeal, on casual inspection, to many lay readers, and it must be admitted that there is much sound factual content and attractive illustration once one has learned to overlook the faults.

The text covers a wide range but the emphasis falls upon certain topics, pre-

continued on page 278

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FLOATING ISLANDS

By Maynard M. Miller*



Recent aerial explorations in the high arctic provide clues to the centuries-old mystery of vanishing lands. Here is the story of a significant flight over the Pole and the illuminating conclusions that it yielded

TAKPUK was an Eskimo. Cruising one day in his sloop about 80 miles off the northern coast of Alaska, he saw what appeared to

be an island. Takpuk was puzzled. He had never seen or heard of land in these waters. His chart showed nothing of the sort.

*MAYNARD M. MILLER has received many honors for his work in organizing and implementing the now-famous Juneau Ice-field Project, and these include a citation from the Junior Chamber of Commerce "for outstanding leadership in the field of geologic science. . . ."

He is Research Associate of the Lamont

Geological Observatory of Columbia University and Director of The Foundation for Glacier Research in Seattle, Wash. Mr. Miller has participated in 20 expeditions to the arctic and has recently completed a two-year Fulbright Fellowship in glaciology at Cambridge University, England.

—Ed.



► TAKPUK was puzzled. With the bow of his sloop on shore, the water at the stern was 120 feet deep.



Courtesy The American Geographical Society

He steered for the island and ran the bow of his boat onto the beach. To his surprise, the water was 120 feet deep at the stern with the bow touching bottom.

With a companion, he landed and explored the mysterious island. Its surface was gently undulating, with small ponds on it. Grass and moss were growing on the island. No driftwood was seen along the shore. There were a good many boulders scattered about, some of them perhaps larger than a man's head.

It never occurred to these men that this could be anything but an island. But when the noted explorer Stefansson heard the story and published an account of it, he mentioned the possibility that this might be drifting ice that had somehow picked up a load of debris.¹

Twenty years later, on August 1, 1951, I was sitting in the nose of a B-29 flying over the area where

Takpuk's island had been found. The day was sparkling clear, but I could see no land, only broken, shifting ice. Where had it gone?

Perhaps we could dismiss the Case of the Disappearing Island if numerous other similar ones had not been "discovered" in the Polar Sea and vanished. There were the Gunnbjorn Skerries and the Brendan Legends. The Sunken Land of Busse was sighted in 1578 off the coast of East Greenland by one of Frobisher's returning vessels and possibly later seen by other explorers—but in a different place. People thought its position had been wrongly figured, but in later centuries no one could find it at all.

In more recent times, there have been reports of Keenan Land, President's Land, Bradley Land, and Sannikov Land—not one of which could later be verified. Perhaps the most famous is Crocker Land, described by Peary in 1906 and duly noted on all maps. No trace of it

could be found eight years later by Commander Donald B. MacMillan.

A U.S. Air Force weather flight to the North Pole on August 14, 1946, gave the first clue to the mystery. Visibility at the time was zero, and a young officer was making his observations by radar. He was startled to see "land" on the radar scope where no land was known to exist. The outline on the radar screen was clearly that of an island about 200 square miles in area. The officer informed the pilot, who verified the plane's position as 300 miles north of Point Barrow, Alaska.

When the crew returned to base, their discovery naturally excited a great deal of speculation. It was coded as "Target X," or T-1, and its existence was classified as a military secret.

It moves

It was not necessary to wait long for confirmation or denial of the island's existence, for daily weather flights were being made over the Polar Sea, and crews were alerted to watch for T-1. Darkness and clouds make naked-eye reconnaissance over this no-man's land virtually impossible for three-quarters of the year, but using radar as the primary detection, crews again spotted T-1. This time, it was several miles from its first position.

Succeeding flights often found difficulty in locating the island, but each time it was reported, it was a little farther east. The shape of the island on the radar screen remained the same.

One day, the mists cleared, and from a vantage point of 18,000 feet above the ice, the crew of a weather plane got a good look at it. Circling lower, the airmen could see that a coastline rose 20 to 40 feet above the surrounding sea ice, apparently impervious to the pressures of the pack. Bright blue lakes, grayish streams, and dark red rocks were clearly visible. The position was again carefully plotted, checked, and re-checked. Certainly it was moving, and it was about the size of Guam.

For the next three years, the ex-

¹"An Eskimo Discovery of an Island North of Alaska," by Vilhjalmur Stefansson, in the *Geographical Review* for January, 1934.

istence of T-1 remained a military secret, and strategists dreamed of making a landing field on it. Apart from its possible military importance, valuable scientific work could be carried out on it if a base could be established there. By October 6, 1949, it had travelled more than 1500 miles from where it had originally been seen.

In the spring of 1950, air crews were advised to search for other island-like masses, and in July a second one even larger than the first was discovered. This was named T-2. A few days later, a third one, T-3, was sighted. Since then, dozens of smaller tabular "ice islands" have

been located in the western arctic and have been spotted on aerial photographs taken by both the U.S. Air Force and the Royal Canadian Air Force.

The first public announcement was made at the First Alaskan Science Conference, held in Washington, D.C., in November, 1950; and I remember my interest and excitement when Col. Joseph E. Fletcher, then in command of the Air Weather Squadron at Fairbanks, Alaska, read his descriptive paper. Afterwards, several of us sat up late into the night conjecturing about the origin, composition, and probable future of these paradoxical

floating "lands." We were especially curious as to where they had come from.

The arctic is a great elongated basin filled by a frozen, land-locked sea, which is over 14,000 feet deep at the North Pole. In autumn, the first thin slush forms over the surface, and remnants of the ice from previous years become consolidated with the freezing of open water between. Gradually, the whole mass solidifies, producing a veneer of new ice over the green-blue sea. Winds break the fresh ice, crushing and tearing it so that open passages, or leads, form between the floes. Individual cakes become broken and scattered, and as the waves spill over them, the waters freeze and weld large sections together again. Sometimes one floe is thrust upon another. So the process goes on—an incessant breaking, churning, and rending of the ice to produce a boundless and incredibly jumbled mass.

The Polar pack varies in thickness from a few inches to scores of feet and averages about thirteen feet in winter. As the long winter night descends, the ice thickens and increases in strength, so that there are fewer and fewer open leads. Great "pressure ridges" are forced up by the grinding action, and the

Maynard Miller



▲ The B-29 Superfortress undergoing a final check-up before starting on the 4100-mile flight to beyond the Pole and back.

▼ LOOKING SOUTHWARD over northeastern Axel Heiberg Island. Nansen Sound, at left, separates it from Ellesmere Island.



▼ A STRANGE "CLIFF" of non-glacial ice (red line) may produce ice islands.





▲ ORDINARY ICE in the Arctic Sea averages 13 ft. thick, whereas the islands are 200 ft. thick or more.



Maynard Miller

▲ SMALL ICE ISLANDS near Disraeli Bay, which could have come from thick land-fast ice. This "shelf ice," strangely, is not fed by any glacier.

currents of the sea carry the mass in a clockwise rotation.

In spring, as the first tentative rays of the slanting sun cross the top of the globe, the sea ice slowly begins to melt. It cracks here and there, and pools of water form on its surface. Small chunks become separated and float apart, and the whole mass becomes thinner, until large sections of it dissolve once again. Broad spaces appear along the southern shores of the Polar basin, and the pack may recede 100 miles or more from the mainland.

But even at the height of the summer melt season, the pack never completely disappears. At the Pole of Relative Inaccessibility (sometimes called the "Ice Pole" because it is the geographical center of the polar ice) and at the geographic North Pole itself, the sea remains covered for the most part with fairly thick ice. Even here, however, leads and broader stretches of open water can occasionally be seen.

This, then, is the Polar Sea. Hemmed in on all sides and constantly churned by wind, tide, and current, the arctic pack resembles a vast jigsaw puzzle whose pieces are continually stirred by an unseen hand and continually changed in shape. Although building up to formidable thicknesses each winter, it is never quite able to withstand the terrible pressures induced by the rotation of the earth.

How then could these large float-
ing islands of ice have come into

being? How could they withstand the enormous pressures at work? Where could ice of such tremendous thickness be manufactured?

I thought of these riddles as I returned to Alaska in July of 1951 to continue my geological work on the Juneau icefield. Urgent duties soon pushed them to the back of my mind, but I kept hoping for a chance to get a firsthand look at these impossible islands.

My chance came while in Anchorage arranging air support for our Juneau project through General William D. Old, the Commanding Officer of the Alaskan Air Command. General Old had the keenest interest in arctic work and was an already well-proved friend of my Alaskan icefield expeditions. During our conference, I asked him if I might later go on one of the Air Force flights over the ice islands. Observations would be useful as a preliminary to landing on one of the islands for a detailed glaciological study.

General Old told me that a special flight had been made in March to check on the position of the islands and also to examine the shore of lands bordering the Arctic Sea in an attempt to find their source. The flight had been arranged by Col. Fletcher, with whom I had talked in Washington at the Science Conference, but severe headwinds and icing had unfortunately restricted the result. Also, it had proved difficult to interpret land-

scapes shrouded under winter snow. But enough had been seen to enliven interest.

"Here's an idea," said General Old. "Col. Fletcher will be arriving this afternoon from Fairbanks. Why don't you come to my office around four o'clock and talk with him. If he plans another survey flight, you may be able to go along."

It was a pleasure to meet Fletcher again. He was obviously still enthused about the "ice island" problem, and we were soon deep in discussion. Before I could suggest it, he turned to me and said: "We may try again to fly along the Canadian Arctic coast, if the weather ever clears up there. Could you come along and help us with some geological answers?"

This was just what I wanted. We left it that Fletcher would wire me when the plan could be carried out.

I did not hear from him again until I came out to Juneau at the end of July. Clouds hung over the city and great sheets of rain beat against the windows of our hotel. All local flying was suspended. There was nothing to do but sit and wait.

I was at my desk finishing some paper work when an attendant advised me of a telegram:

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JOE FLETCHER.

I checked at once with the pilot of the plane that had been loaned to us for the Juneau icefield work by the Air Rescue Service.

"Not a chance of these skies clearing for at least three days," he told me. "Besides, a plane has just crashed in the mountains northwest of here, and we'll have to look for it."

This meant that the delivery of our equipment would have to be delayed for at least a week—just the time I needed to accompany Fletcher.

I travelled by local transport to the fair-weather side of the range at Whitehorse, Yukon Territory, and flew to Fairbanks just below the Arctic Circle.

Terris Moore, President of the University of Alaska, had happily been invited to join our flight and was at the airport when I arrived. In addition to the crew, there was Major Lawrence Koenig, ice reconnaissance officer for the 58th Strategic Reconnaissance Squadron, who had already contributed much to our knowledge of the ice islands.

A tone of suppressed excitement permeated our group as we assembled for the briefing. The first good

weather report in more than eight weeks had been received from the high eastern arctic. To take advantage of it, we could not delay a day.

Between the Clouds

We took off from Eielson Field in a converted B-29 Superfortress in mid-morning on August 1, 1951 with Capt. Pat Bass as pilot and Capt. C. P. Bloom as navigator. Once over the Brooks Range, we headed out across the broken drift ice of the Beaufort Sea. The Arctic Ocean for 50 miles or so from the mainland was fairly free of floes. Between 71 and 72 degrees N. latitude, very open pack ice persisted. More water than floes was seen until we entered a more congested zone extending up to 74 degrees.

Flying at an altitude of about 10,000 feet instead of the usual 18,000, we were in and out of cloud banks until, about a hundred miles off Cape Prince Albert at the northwestern end of Banks Island, our vision below became completely obscured.

While crossing McClure Strait, the radar operator picked up land

ahead. This proved to be a stretch of coast on Prince Patrick Island, the westernmost of the Canadian Arctic Archipelago. We were on course. We skirted the northern coast of Prince Patrick Island and Brock Island and then on across Borden Island to Cape Isachsen at the northwestern tip of Ellef Ringnes Island. Through a nearly solid undercast, we had an occasional glimpse of tight-laced pack and field ice pressed against the brown and desertlike shores.

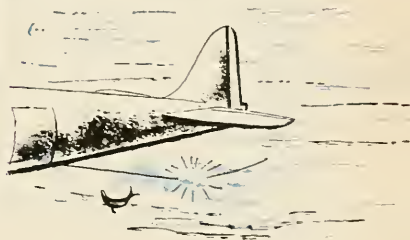
We could make out the patterns on the ground produced by frost action and summer melting. It was disappointing not to have a completely clear view, since I was interested in aspects of the physiography of these seldom-seen islands. At least, we could see that they were low, relatively gentle masses of land, free of glaciers. We feared that the hoped-for view of Ellesmere Island off to the north-east would likewise be obscured. But a new set of weather reports still gave promise of clear weather.

At 80 degrees N., Captain Bass swung his controls to a more northerly course, and we began to make out, under a vast stretch of blue sky, at a distance of at least 200 miles, a startling view of snow-crested highlands, glistening white with glaciers. These were the Challenger Mountains and other ranges of Ellesmere Island. Soon everything was under a magnificently cloudless sky.

Below, the strangely arid ground of Axel Heiberg Island shimmered into view. With both my cameras working, I photographed in still and motion pictures a record of high arctic land ice. In depressions on the glacier's surfaces, I could see deep blue melt-water lakes and



▲ FLYING low over T-2. The dark streak is a patch of blue ice. It apparently formed in one of the troughs that mark the otherwise smooth surface.





Maynard Miller

a sheer cliff of banded sedimentary rock bounding the south edge of ice-choked Nansen Sound.

For the next two hours, our aircraft traversed and circled the deeply cut re-entrants, narrow fjords, and twisting glaciers along this spectacular coast, glowing in pastel shades and peaceful shadows—a scene of lifeless solitude and frozen beauty.

Then between Phillips Bay and Markham Bay, we caught sight of a most unusual ice feature—a sheet of 50 or more miles of ice projecting out from the shore of the Polar Sea. At first, it was intermittent, but especially between Yelverton Bay and Disraeli Bay it was continuous. On the seaward side, a 20-foot cliff of ice delimited it from the pack. Had we been in the antarctic, this would not have been surprising, because “shelf-ice,” presumably afloat and usually connected with glaciers on the mainland, is well known. But so far as I know, a true “ice shelf” had never before been reported in the arctic. And since shelf-ice of the antarctic sort was just what the ice islands seemed to call for, it was a temptation to jump to conclusions. But I could see important differences between this shelf-ice and that of the antarctic.

There were distinct furrows on it, making it look like a great plowed field, with clean snow on the ridges and blue ice and melt-

water showing as long dark lines in the depressions. We estimated that the waves of ice were 100 to 300 yards apart and the individual rolls between 5 and 15 feet high. Of particular interest was the fact that this whole series of undulations ran across the surface of the ice in a manner strangely parallel to the general trend of the coastline.

This ice was much more severely melted than any of the antarctic types. But a more important difference was that it was moored to an almost glacier-free shore. In fact, at several places, I could see where land rivers had flowed from the rocky mainland right onto the ice, sometimes straight across the furrows to form extended river channels clear to the seaward edge. This proved that the surface of the shelf sloped gently down from the land to the sea and that it was essentially solid ice. It also indicated a surface draining pattern unheard of in the antarctic. Lt. Pelham Aldrich of the Nares Expedition in 1876 and later Peary in 1905, both of whom travelled along this coast, thought that the broad rim of shore ice was of land origin and had been formed by glaciers. In fact, Peary referred to it as the “ice foot” and the “glacial fringe.” But from what I could see, the shelf had never moved down from the mainland. I was convinced that it was distinctly non-glacial in origin and had been built up more or less

◀ **McCLINTOCK BAY**, in Ellesmere’s “shelf-ice” zone. Note ridges and furrows that suggest this as source of ice islands.

in its present position by processes not unlike those that form ordinary sea ice. I could only explain its considerable thickness, as compared with the fringing pack, by the fact that it had been held fast to the land over many years, thus preventing its annual breakup and allowing accretion to continue without interruption.²

Close to the seaward edge of the shelf, we passed over a tabular sheet of ice about a square mile in area. It had all the characteristics of the adjacent land-fast or grounded ice. Almost certainly it was a segment that had broken from the “shelf” to drift free in the pack—the very evidence we needed.

One of the big ones

Then, about 20 miles north of Disraeli Bay, we made a most startling discovery. There, within sight of land, floated a huge triangular chunk of flattish ice—about 17 by 20 miles!

Major Koenig, shuffling photographs, exclaimed, “That’s it! It’s T-1, all right. What luck!” And then turning to Terry Moore, he explained his excitement: “It’s been lost for two years.”

My own excitement reached a climax as we made two low passes over it, which brought us down to less than 100 feet above the surface. Here, at close range, we could see again the strange corrugations we had viewed with such interest on the ice shelf of the near-by coast.

We made one final pass over the island at 4000 feet before heading out to sea on a northerly track.

We had been too busy to talk. Now the cabin buzzed with conver-

² This is probably related to the type of heavy polar ice that early explorers termed “paleocrystic” ice, “floesbergs,” and so forth. Its excessive thickness is attributed by Stefansson to the combined effects of strong westerly winds and high “storm tides” along the shores of the Polar Sea (see his *Friendly Arctic*, pp. 223-224). The first person to photograph such ice and to detail its nature and probable origin was E. K. Lefringwell in his painstaking U. S. Geological Survey monograph “The Canning River District, 1919.” This paper gives a useful summary of the early literature pertaining to this type of “old ice.”

► GENERAL LACK of connection with glaciers makes this "shelf ice" in McClintock-Disraeli Bay area unlike antarctic's.

sation. Koenig and I were discussing how an "ice shelf" could possibly have persisted in this region where glaciers have been shrinking and snowfall is known to be scanty. I theorized that it might be a relic of the great Ice Age, or more likely of a lesser cold period in the more recent past. I suggested that in spite of the vast surface-melting in summer, it was being maintained by sea water freezing on the underside during the coldest winter months. This was along the lines first advanced by Professor Frank Debenham, of the Scott South Polar Expedition, in his controversial theory on the origin of the Great Ross Barrier in the antarctic.³

Koenig interrupted:

"Before you get too absorbed in technical thoughts, look at this,"—and out came the most tremendous club sandwich I had ever seen—chicken, lettuce, and fresh tomatoes, to be washed down with a jug of steaming coffee from the cabin thermos. With a nonchalance I scarcely felt, we settled back for lunch, as the plane drummed onward toward the Pole.

After lunch, I searched through my field notebook for a quotation which Major Donald Shaw, of the Air Force's Arctic Information Center, had brought to our attention. It was from Peary's *Nearest the Pole*, written in 1906, and described the very same coast over which we had flown:

"The new light snow made fine snowshoeing, but was very heavy for the dogs and sledges; and this heaviness was accentuated in the series of rolling swells which are a feature of this peculiar ice foot along here. These swells are on a large scale, and reminded me very strongly of portions of the icecap of Greenland. If they are not huge



Maynard Miller

drifts, I do not know how to account for them. Off Ward Hunt Island and especially the western end, they are particularly marked and here they blend into drifts formed in the lee of the island. From the summit of the tumulus, I saw the ice ahead of us in the same condition: a gigantic potato field with a long blue lake or a rushing stream in every furrow."

"You know, Larry," I said, "it's just possible someone has been on T-1 or T-2. If this is their birthplace, as I feel sure it is, then men from the Nares' Expedition, Peary, and some of these other early explorers probably travelled right across them *before they were launched.*"

Pleased as we were with this part of our project, we were not fully satisfied, for we also hoped to relocate T-2, which had last been seen in June, fairly near the Pole.

Between latitudes 83 and 85 degrees, we passed over the tightest pack yet seen, with giant floes and much pressure ridging everywhere. Above latitude 85, there was another broad area of undercast, and we doubted we could find T-2. We had been airborne for eleven hours, and the plane would soon reach the outer safety limit of its fuel supply. At 87 degrees, less than 200 miles from the North Pole, the undercast gave way to a cold front, and the reflected light of the midnight sun gleamed from the endless pack.

And then came the expected announcement. Our fuel radius had been reached. The navigator's decision was final, for in polar flying, it is he who actually controls the plane. We headed back for Alaska.

One last look


I decided to strain through just one more tedious round of horizon-scanning with the binoculars before we became completely enveloped in mist again. Presently I picked up a faint unconformity on the horizon in the clear area off our starboard beam. I nudged Captain Bass and pointed. He veered slightly for a better look. When I saw it again, there was no question of what we had found. The nose of our plane swung through an arc of 120 degrees to close in on T-2.

What an exciting piece of luck! I had seen it almost at the limit of visibility. Had our flight taken us only a mile or two farther east, we should have missed it altogether.

At that moment, we were 150 miles beyond the North Pole on the other side of the world. As we swung down for a closer look, the navigator advised us that there was only enough fuel for one low pass. Captain Bass brought the Superfortress so low I almost thought we were coming in for a landing. This was not too discomfoting a thought, for with the surface only 50 feet below, T-2 presented the most gigantic and unbelievably


continued on page 271

³ "The Problem of the Great Ross Barrier," by Frank Debenham, *The Geographical Journal*, Vol. CXII, Nos. 4-6, October-December, 1948, pp. 196-218.



◀ A FINE SPECIMEN, with most of its parts intact. This *Flexicalymene* is an average-sized trilobite. But *Terataspis* reached a length of 27 inches.

What is a TRILOBITE?



You may find one in rocks that were laid down beneath the sea 195 million years or more ago. Here are a few facts about their life and times

By JOHN H. GERARD*

Photographs by the author

IF YOU have had anything to do with fossils, there is a good chance you have seen a trilobite. They were quite abundant in some of the early periods of earth history, at a time when there were no animals with backbones and few large ones of any kind. Most of the trilobites were only a few inches long, but some measured as much as 27 inches. Their legs were delicate and have rarely been preserved.

Many areas of the United States were once covered by seas in which the trilobites lived. For millions of years they roamed these waters nearly unmolested. Then the fishes evolved, and though many of the trilobites are thought to have been able to roll up in their shells like a ball, they were no doubt eaten by

fish. Their skeletons were on the outside of their bodies, and they shed them periodically. So what we find is usually the fossilized exoskeleton, rather than the whole animal; the underside is usually embedded in rock, with only the back surface protruding.

Over 1200 species of trilobites have been named, and there is great variation among them. Some had spines and bizarre ornamentation, others were smooth. All have been extinct for about 195 million years.

Because of their abundance, trilo-

bites are useful to geologists in indexing rock layers, and there is a large technical literature on them.

The eyesight of trilobites varied. In some, the eyes were constructed of hexagonal sections, while in others they were on stalks, somewhat as in modern crabs. Some apparently had no eyes, while others had eyes with 15,000 facets.

Trilobites are thought to have laid eggs, and objects that may be fossilized trilobite eggs have been found. The first immature stage after hatching was free-swimming and probably looked like the nau-

*JOHN H. GERARD has been interested in animals from an early age and has been taking photographs since he was eleven. He is a full-time photographer

specializing in outdoor subjects with educational value. His pictures have appeared in more than 130 publications, and some have won prizes.—ED.



LIMESTONE BLUFFS along the Mississippi and its branches have yielded many trilobites. This site is near Alton, Ill. At left: Four *Flexicalymenes* from which excess rock has been expertly chipped.

▼ **FINDING TRILOBITES.** Geologists determine age of rocks by trilobites and other small fossils as much as by the more dramatic large ones.

plus stage of modern primitive crustaceans. As growth progressed, the outgrown exoskeleton was repeatedly cast off. Trilobites seem to have been creatures of the salt water. Neither fresh-water nor land forms have been found. Modern crabs, lobsters, and crayfish may have descended from the same common ancestor as the trilobites.

Trilobites are thought to have fed on other invertebrates and plants, and some were probably scavengers. Some tunneled through muddy bottoms. In any case, it has been a long time since any of them lived. But there were so many of them and they fossilized so well that you may easily find one if you look in the proper location. Some amateurs, in fact, have made large collections.



WHAT IS A TRILOBITE?





▲ A THERMITE FLARE was fixed to this boomerang to show its flight. On the outward path, the boomerang spun rapidly. Returning, air resistance almost stopped its rotation.



The Mystery of the **BOOMERANG**

By JOSEPH J. CORNISH III

One of primitive man's most ingenious inventions

yields its secrets to the science of aerodynamics

THERE is a certain, almost mystical fascination about the very idea of throwing away a stick of wood and seeing it return to fall at your feet. To primitive people who did not know the trick, the boomerang might appear to border on the supernatural. But lest we exaggerate our own skill in aerodynamics, let us admit that, although the word "boomerang" has become a part of our language, the puzzling behavior of this weapon still baffles many experts. The mystery surrounding the boomerang is so great that one of the better known encyclopedias states that, "All efforts by the most skillful mechanics to imitate the boomerang have failed."

Whenever the boomerang is

▼ THE AUTHOR'S SON showing the proper stance. A returning boomerang should be thrown in a perpendicular plane, not skimmed.



mentioned, the next thought that comes to mind is Australia, and without a doubt the land "Down Under" can justly claim pre-eminence in this regard. The very name, boomerang, is said to have had its origin in the aboriginal word for wind. And although the crescentic throwing stick was in use among natives in both Asia and America, the Australians alone seem to have lit upon the trick that enabled them to make it return. Others found advantage only in the fact that a flat crescent-shaped stick will fly faster and straighter than a rod-shaped or knobbed one.

For us here in the United States, the boomerang is no farther removed than the Southwestern part of our country. Here the Hopi, Acoma, and Zuni Indians, who live in New Mexico and Arizona, have used a form of the boomerang since olden times. According to one of the myths of one tribe, their gods disclosed to the ancients five weapons with which to hunt. Among these five was the boomerang. Even here a note of mystery is present, as it is said that the gods cautioned them not to use the boomerang just anytime, "... as it had so much power that they might destroy something." But today the young men of the tribe use this whirling weapon to hunt rabbits, and they mostly refer to it as a "rabbit stick."

Traces of the boomerang have been uncovered in many other places on earth, including India, Celebes, Borneo, and Ethiopia, where it is known as the *luin*. Strabo, the ancient Greek geographer, mentions that the Gauls

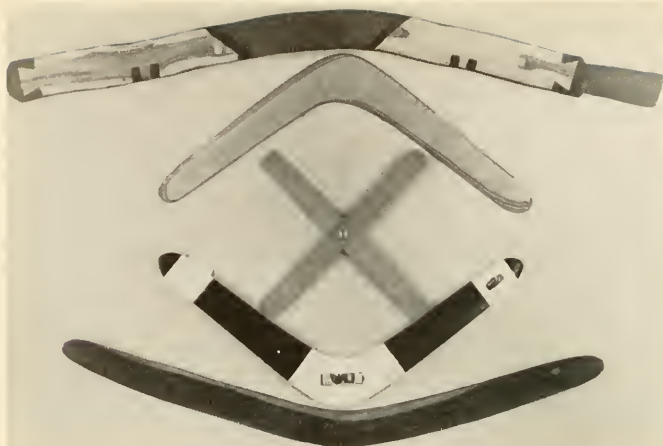
may have used a form of the boomerang in hunting birds. In ancient Thebes, it is depicted in both carvings and paintings, and it has been used in Egypt even down to recent times. Until the beginning of this century, whole army divisions were equipped with war boomerangs. Only after witnessing the whirling flight of a long and heavy boomerang can one realize the demoralizing effect of such a weapon. The boomerang has been used for hunting, for sport, and for war, and in the Northern Territory of Australia near the Rose River, a special boomerang is used in female puberty rituals.

What then is the magic of this sickle-shaped stick? The answer, of course, is obvious. There is no magic at all. The boomerang employs no special or extraphysical properties. Its bewildering motions are the result of the coupling of two well-known physical phenomena. It embodies the action of the gyroscope and the forces produced by the air flowing over its curved surfaces. Both of these principles are very well understood, and today many not so skilled "mechanics" can and do duplicate the boomerang.

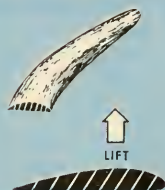
The boomerang, or "kiley" as it is sometimes called by the Australians, is usually 2 to 4 feet long and is generally bent in the middle at an angle of 90 to 120 degrees. There are two main types of boomerangs: the return type, which is usually used for sport or for hunting birds, and the non-return type, which is used in war or in hunting large game. In the return type, one side is flat and the other is curved like the wing

*JOSEPH J. CORNISH III is an aerodynamicist in the Aerophysics Department of Mississippi State College, where he received an M.S. degree in 1951. Engaged in research for the Air Branch, Office of

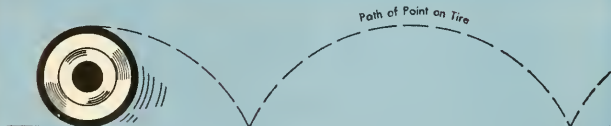
Naval Research, he has published both technical and popular articles on his work. This article is the outgrowth of the author's hobby of studying natural flight and man's early attempts to fly.—Ed.



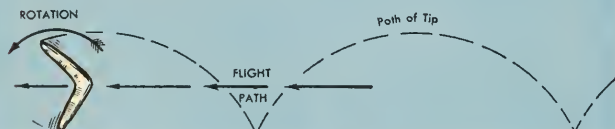
◀ ALL THESE BOOMERANGS are of the return type except the Hopi "rabbit stick" at top. The black and white one has a flashlight bulb and battery to trace its flight. The bottom one is from Australia.



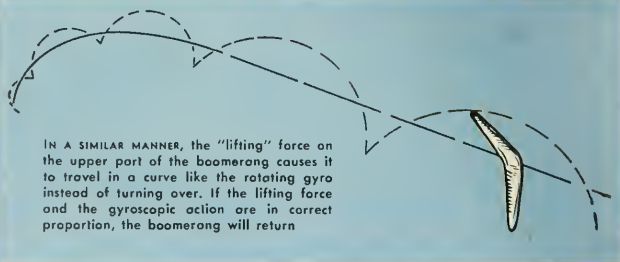
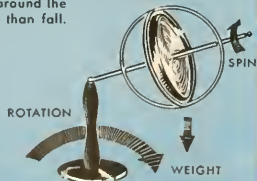
A CROSS-SECTION similar to that of an airplane wing is seen in the return type of boomerang. This causes a "lift" to be exerted on the blades, altering the flight. The symmetrical shape of the non-returning boomerang only streamlines it.



THE MOTION of a boomerang may be compared to a wheel rolling along the ground: the top of the boomerang moves much faster than the bottom. Owing to this difference, most of the "lifting" force is concentrated on the blade that is uppermost as the boomerang whirls through the air.



THE SECOND PRINCIPLE that governs the flight of the boomerang is that of the gyroscope. When a spinning gyro is placed as shown, its weight causes it to rotate around the pivot rather than fall.



IN A SIMILAR MANNER, the "lifting" force on the upper part of the boomerang causes it to travel in a curve like the rotating gyro instead of turning over. If the lifting force and the gyroscopic action are in correct proportion, the boomerang will return.

➤ **NON-RETURNING BOOMERANGS** generally have less curvature than the returning ones. In this group of Australian boomerangs, only the second one from the top is the return type.



Smithsonian Institution

generated, and this boomerang flies relatively straight. A strong man can throw one of these large war boomerangs more than 150 yards, and it will strike with deadly force. The boomerangs used by the Hopi Indians to hunt rabbits are of the nonreturn type but are smaller than the usual war boomerangs. On some of these boomerangs a handle is carved at one end for convenience in throwing.

Although most boomerangs are made of wood, other materials have been used. For instance, in the southern parts of India there is a boomerang of steel, in the form of a knife. Persons unfamiliar with boomerangs are apt to suppose that all can be made to return, and it has been said that this steel boomerang will come back to the thrower, but I cannot vouch for that. In this part of India there are also boomerangs carved of ivory. Some of these are only six inches long.

Recently, the boomerang has become popular in this country, and several commercial types are available. Most of them are made of plastic, some of laminated wood. The majority are similar to the Australian return type. Another

shape that was popular some time ago was in the form of a cross or an "X." This type is, in effect, a "double" boomerang, but its behavior is the same as the other return types. Others made as toys in this country have assumed many odd shapes. One, called the Boomer-Bird, resembled an eagle with outstretched wings. Despite their novel appearances, all of these boomerangs operate on the same principles as the ones tediously carved by the Australian aborigines, who themselves have tried some unusual styles. In some parts of Australia, the boomerangs are made with a sort of horn or beak at one end and are known as "beaked boomerangs." Many explanations have been offered for this design, but the exact reason

appears to be lost in antiquity. The makers seem to have no knowledge of the fundamentals of the boomerang but merely follow previous examples.

The art of throwing a return-type boomerang is easily learned with a little practice. The Australians have thrown the "kiley" as high as 150 feet into the air, and some are able to cause it to circle as many as five times before returning. It is even claimed that some can make the stick bounce on the ground at some distance and still return to the thrower. Throwing the return boomerang can be a dangerous game, however, and it has often been said that the boomerang is more hazardous to the thrower than to the target.



➤ AS SHOWN on this map, boomerangs are not limited to Australia. They have been used in Egypt, India, Ethiopia, Celibes, and Bornea. There is reason to believe that the ancient Gouls used them to hunt birds. In the New World, the Hopi Indians have been familiar with the boomerang for many years.



▲ THE FEMALE deposits her eggs in masses of 2000 to 3000, cemented to leaves, branches, and rocks overhanging running water. Each is circular and about an inch in diameter. A chalky coating makes them resemble shells from a distance.



▲ THE TINY HELLGRAMMITES hatch out, fall into the water, and hide under stones. In a matter of years, the hellgrammite reaches a length of about three inches. The dark brown, leathery-looking creature has a vicious bite; hence the nickname toe biter.



▲ WHEN READY to go into the pupal stage, the hellgrammite crawls out on the bank and hides under a stone or some other protective object. It often crawls some distance before it finds a favorable place to locate itself for pupation.

The complete life cycle of The *Dobson Fly*

The drama of its changes shown in photographs

By GEORGE A. SMITH



THE larval form of the dobson fly makes excellent fish bait and is familiar to anglers as the hellgrammite. Boys living near suitable streams often make extra spending money catching and selling "hellgrammies" to fishermen. But many who know this insect in its larval form are not familiar with the metamorphosis that transforms it into a large, winged adult.

The horned corydalis, or *Corydalis cornutus*, as it is called, is a poor flyer and is frequently found around outdoor lights near streams in late

spring or summer. In its feeble attempts to use its wings, it may fall to the ground, where it can easily be caught for close examination.

The female can inflict a bite when picked up carelessly. The male looks more vicious than it really is. The extremely long extensions on its jaws are harmless claspings organs used while mating.

The life cycle of the dobson fly through egg, larva, and pupa to adult is shown in these photographs.



▲ THIS ASSEMBLAGE was found under a flat stone located in a moist, shaded spot along a stream well stocked with hellgrammites. A half dozen or more hellgrammites were in the act of passing from the larval to the pupal stage.



▲ THE PUPA of the dobson fly looks ghostlike, but it retains most of the viciousness of the hellgrammite and will even try to bite. Pupation requires one to two weeks.



▼ THE PUPA transforms into this beady-eyed adult, with stiff-looking antennae and a wingspread of over five inches. The male is slightly smaller than the female. Both have cinnamon bodies and grayish-white wings with little whitish dots. Adult dobson flies probably eat nothing. After mating and depositing their eggs, they soon die.





Poison Ivy— the three-fingered **MENACE**

Just because you've never had it, you needn't think you're immune—everyone is the first time, but 250,000 victims suffer severely every season

By GARY WEBSTER

EVERY SPRING, U.S. magazines and newspapers break out with a rash of articles on poison ivy. This will be an unusual year if this vine is not condemned as "Plant Public Enemy Number 1."

That epithet is comparatively mild. Here are just a few of the labels given to poison ivy in the

past ten years: the three-fingered menace, scourge of the woods, old toxico, botanical Judas, creeping villain, green devil, public pest number one.

Viewed from a different perspective, there seems good reason to conclude that all these smears upon the plant's character are unfounded.

NATURAL HISTORY, MAY, 1956

Instead of being a Borgia of the back yard, poison ivy is an innocent bystander in a colossal natural drama.

The suffering to humans is widespread, of course. There is no debate on that score. Precise figures have never been gathered, but estimates of the number of cases in the United States usually start at 250,000 a year. Three or four times as many, comparatively mild, do not involve treatment by a physician.

The greatest suffering is a direct result of picnics. But poisoning is almost an occupational disease among foresters, gardeners, linemen, civil engineers, and even naturalists. In May, 1954, eighty nature-conscious Boy Scouts came down with the familiar blisters after a single New Jersey outing.

Ivy was a major source of annoyance and delay in building the Pacific Railroad, 1853-56. More recently, it caused an estimated 80 per cent of all lost-time illnesses among members of the Civilian Conservation Corps. At least two children are known to have died as a result of severe poisoning.

Most victims yearn for relief without attempting to estimate the financial damage. Not so Mr. and Mrs. John J. Loughran, of the Bronx. With their son of four years, they were infected during a picnic in a public park. So in August, 1947, they filed suit against the commissioners of Westchester County Park. Their suffering and related losses, said the plaintiffs, entitled them to redress amounting to \$12,500. Judges didn't concur, though.

Captain John Smith wrote the first description of the poisonous creeper, observing that it is "in shape but little different from our English yvie." Smith admitted that it caused redness, itching, and blisters, but he leniently insisted that it really had "noe very ill nature."

Poison ivy is native to North America. It flourishes from the St. Lawrence River to beyond the Rio Grande, and from Cape Hatteras to Puget Sound. California and Nevada are the only states where it is comparatively rare. Under natural

conditions, poison ivy is not found in areas with very low annual rainfall, at high altitudes, or in the shade of dense forests.

Few plants are more versatile. In the East and Middle West, it occurs as a climbing or trailing vine and as a low shrub. Sometimes a single plant bears leaves whose edges are in many forms, varying from smooth to deeply notched. Leaves are always divided into three leaflets; usually their upper surfaces are glossy, almost as though varnished. Other clues to identification are more technical or less certain.

Unwelcome Relatives

Poison oak, a prolific shrub of the Far West, is so closely related that botanists cannot agree to calling it a distinct species. Many consider it simply a geographical variant of the eastern plant.

Poison sumac, a close relative of poison oak and poison ivy, contains the same toxic agent, urusiol. But since the sumac normally grows on the edges of acid-water bogs, it is encountered less frequently and causes less injury.

Actually, all members of the trio belong to the genus of the sumacs and are members of the cashew family. Poison ivy is not closely related to English ivy, which belongs to the ginseng family, nor to the popular Virginia creeper. It gets its common name from the influence of John Smith and other early observers.

North America has some 15 of the 150 listed species of sumac, but only 3 of ours are poisonous. All members of the cashew family, whether harmless or dangerous, produce milky or resinous juices.

As late as 1800, it was commonly believed that poison ivy exuded a gas which irritated all who came within 20 feet of a plant. One experimental study convinced its author that the vapor was released only at night, on cloudy days, or in the shade. Later analysts found conclusive evidence that the irritant was not a gas, but this theory lives on in some quarters in spite of having been disproved. Another erroneous notion, which some investiga-

tors accepted as late as 1916, was that a bacterial organism in the plant produced all the trouble. However, few serious scientists ever endorsed this theory.

Faltering steps toward real understanding were first taken in the Orient. Lac trees, cultivated in Japan and China for at least 1400 years, belong to the same genus. Like poison ivy, they exude a toxic juice. Treated by native methods, the juice oxidizes, changes color, and eventually yields the black lacquer that has been so prominent in oriental art.

Lac workers take routine precautions in handling resins but are sometimes poisoned. There have been many cases of dermatitis in America among users of lacquered objects such as mah-jongg sets and oriental trays.

As early as 1833, Japanese scientists set out to find the toxic agent. Yoshida launched a chemical attack on the yellow sap and eventually isolated a fluffy white powder which he considered the villain. There is some uncertainty about what the Japanese obtained; it was undoubtedly a laboratory compound rather than the pure plant poison.

At Harvard Medical School late in the century, a nonvolatile oil was isolated from the resin of the poison ivy plant. It proved so potent that mild poisoning resulted from exposure to a solution of one grain of it dissolved in 60,000 times as much olive oil.

Still, there was ample evidence that basic ingredients had not been isolated. Extracts were made with alcohol, ether, and gasoline. Both in Japan and in this country, extremely potent poisons were found. Most forms were considered to be relatives of carbolic acid.

Matters rested at about that point until 1940. That year, Dr. Charles Dawson of Columbia University decided to crack the chemical riddle of poison ivy. For his initial try, he gathered 80 pounds of bark—and finally extracted 2 teaspoons of oil.

Thirteen years of investigation passed before the end was in sight. Ten of Dr. Dawson's students wrote

Sisters under the Skin



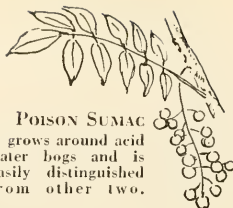
POISON IVY

It always has groups of three glossy leaflets.



POISON OAK

It is so closely related that many consider it only a geographical variant.



POISON SUMAC

It grows around acid water bogs and is easily distinguished from other two.

doctoral dissertations on phases of the problem. In January, 1953, he announced the discovery of ivy's toxic agent—four complex compounds mixed with, and partly dissolved in, one another. Each has a basic structure like the benzene ring, famous in early molecular theory. Carbon, hydrogen, and oxygen are the ingredients.

That in itself is enough to cause the ivy-hater to take thought. Complex combinations of carbon, hydrogen, and oxygen form the most common and most abundant of plant and animal products. They provide food, clothing, shelter, drugs, dyes, and myriad other materials essential or useful to men.

Many varieties of sumac are high on the list of valuable plants. Oddly, their worth stems from compounds that the living chemical factories build from the same ingredients that form ivy's poison.

Sicilian sumac produces a juice that provides some of the best tanning materials known. It has been a staple in the leather trade for many centuries. Tannic acid, from the same source, is used in making ink and as an emergency treatment for some types of poisoning.

Other cousins of poison ivy furnish the toxic materials that give us oriental lacquer. Still another member of the family, the "wax tree" of Japan, produces fats of quality and quantity satisfactory for making candles. One relative native to tropical America provides most of the cashew nuts of world commerce, of which the U. S. alone has long consumed more than 25 million pounds a year.

Strangely, the cashew stores its toxic resins in the husk it builds around the nuts. Cashew oil, long an undesirable by-product of the cashew kernel industry, is now an important article of commerce. Its chemical structure makes it valuable in the manufacture of varnishes, insulating material, floor tile, typewriter rolls, and even auto brake linings.

Tannin, lac, and cashew oil are products of plant metabolism. Each is manufactured of carbon, hydrogen, and oxygen. Each has properties which make it valuable to man. So the plants are prized. Resin from poison ivy is closely related to these commodities but has no known use, and the plant that produces it is despised.

Why Poisonous?

One may well ask why poison ivy and poison oak produce their toxic juice. Naturalists once thought the answer was obvious. Poisons were considered to be protective devices, produced in many varieties of plants to prevent herbivorous animals from eating them.

Applied to poison ivy, this view falls very flat. For the toxic element seems to have little or no effect upon natural enemies of the plant. Cattle, sheep, goats, and pigs eat it without visible harm. U. S. forest rangers declare that horses actually like it.

Fence Beautifier

In altering the landscape, man has provided many perfect perches for poison ivy.

When the potency of the juice is studied, human volunteers must be used—for no laboratory animals are sufficiently susceptible to be of help. The ill repute of poison ivy stems entirely from the fact that it is highly toxic to the human skin.

Centuries ago, early students of nature surveyed the animal kingdom as known to them and concluded that the human skin is unique. That verdict still stands. Practically all animals are protected by a heavy coat of hair, feathers, or other natural shields. Those few creatures that are relatively hairless, like the hippopotamus and the whale, are notorious for tough hides. Man alone has a thin and sensitive skin that is protected only on top of his head.

Poison ivy rarely affects a hair-shielded scalp. It seldom causes inflammation at the point of most frequent contact—the palms of the hands. There, the hornlike growth of *stratum corneum* is usually so thick and tough that the poison does not penetrate. It does its painful worst in areas where the skin is both tender and unprotected.

Now the woodland pageant is beginning to take definite shape. Some kinds of sumac, in the course of their normal processes of meta-

Philip Gendreau





Philip Gendreau

bolism and growth, produce special compounds. Though odds against such a situation are very great, it happens that these substances are highly poisonous to the queer kind of skin that covers *Homo sapiens*.

Now the stage is set. There is a high potential for poisoning—provided that skin and sap can be brought together. Several factors, apparently unrelated, have operated in North America to produce maximum opportunity for contact.

One of them is man's reshuffling of forest patterns. Poison ivy doesn't thrive in areas of dense growth, where treetops are closed overhead. Plenty of sunlight is needed for maximum development of the plant; humans have provided this by cutting many great forests and thinning most of the rest.

Again, the vine form of poison ivy grows most effectively when it has something on which to climb—a frame that will give it elevation and access to the sun. Stone walls, rail fences, wire fences, telephone poles, wicket gates, old barns, cowsheds, summer cottages, picnic shelters, dahlia poles, picket fences, and half a hundred other devices are precisely what ivy needs.

Climbing places so generously provided by humans also serve as perches for birds. This accelerates the process, for the berries of poison ivy and poison oak are rich in vegetable fat and are a favorite food of doves, crows, wild pigeons, road runners, woodpeckers, and many other birds. When the leaves drop off in the autumn, the white or yellowish fruits are visible for long

Wall Flower

Poison ivy is partial to stone walls and makes them even less scorable.

distances. Result: in California alone, fruits of the poisonous plants have been found in the stomachs of 38 species of birds. The seeds are not harmed by the digestive juices, and the birds perch on poles, fences, and branches of trees to drop them, nicely accompanied by a supply of fertilizer.

Just as floods and dust bowls have resulted from other human activities, so the present abundance of poison ivy stems from the boost which man has given to it.

Sensitivity Varies

Actual poisoning is now believed to be closely related to typical allergic reactions. Sensitivity varies widely from one person to another. Newborn babies, Europeans, and Eskimos show no ill effects from the first exposure. Some blister at the second contact. Others may not be affected for 50 or 100 times. Alas, once sensitivity develops, it is usually retained for life.

Without touching the toxic resin, you run no risk of inflammation. This does not mean that the plant itself must be touched. Residue may linger for months on gloves, tools, firewood, shoes, or clothing. Many persons have contracted severe

Tree Climber

Small boys who yearn for upper branches should look carefully before shinning up.

Arthur C. Parsons from *Black Star*



cases of ivy poisoning from petting animals that had run through the plant. In one classic case, the inflammation stemmed from having changed a tire that had been driven through underbrush.


The leaves and stems of the plants are tender and most easily bruised at the very season when picnickers rush to the woods in greatest numbers for a spring or early summer outing and shed as many clothes as possible.

Adding all the factors, it seems that poison ivy isn't really vicious, after all. It is caught in a vast network of biological and chemical causes and effects which it neither initiated nor controls. Thin-skinned, forest-cutting, fence-building, picnic-going creatures have reshuffled the pattern of North American life. In the process, they have become victims of the plant whose expansion they unwittingly fostered.

New chemicals promise to help in the warfare on ivy and its relatives. Fresh medical advances may reduce the severity of its attack. Still, the best way to deal with poison ivy is to recognize it and leave it alone—or follow expert advice in fighting it.

AMNH





Roger Tory Peterson= TWENTIETH-CENTURY AUDUBON

◀ WITH A CAMERA GUN designed by Dick Borden, Dr. Peterson prepares to take slow motion flight pictures.

Charles Mohr, from *National Audubon Society*

A GENERATION ago the study of birds was chiefly for museum men and a sprinkling of university professors. Today it is estimated that there are close to five million adult Americans and hundreds of thousands of school children who have an interest of some kind in birds.

This phenomenon is not confined to this country, for here and abroad the study of birds has gained a widespread popularity in the past fifteen years which is nothing less than astonishing.

Roger Tory Peterson—one of the world's foremost authorities on birds and a man whose bird books in 7 languages are currently selling 100,000 copies a year—has an explanation all his own for this prevalent interest:

"Birds can fly where they want to when they want to," he observes. "At least so it seems to us, who are earthbound. They symbolize a degree of freedom that we would nearly give our souls to have. Perhaps this is why bird watching has almost become a national hobby in

Britain and is rapidly becoming one here.

"It is an antidote for the disillusionment of today's world, a world beset by pressures it has never before known. Many men in business and the professions find in birds a much-needed balance, a release from their highly complex affairs and the artificiality of the city.

"Housewives find in birds a pleasant relief from the routine of the home, and children enjoy their pursuit for the outlet it gives their abundant energies. Boys in their

Teacher, artist,
and outdoor scientist,
he has probably introduced
more people to the
delights of bird-watching
than any other
person in history.

By
CEDRIC LARSON



An eleven-week-old bald eagle.

teens make the keenest bird recorders, for once they fall under the spell of the 'lure of the list,' they play the game for all it is worth."

Dr. Peterson points out that in the eastern half of the United States, from the Atlantic Ocean to the 100th meridian, which runs from central North Dakota through central Texas, there are approximately 440 different kinds of birds. In 35 years of watching, Peterson has seen all but 4 of them.

This modern-day Audubon is what a sports writer might call a triple-threat man. Besides being an ornithologist of the first caliber, he is a skilled artist, a lecturer, a writer, and an expert photographer. He is the author of scores of articles and booklets on birds, and his *Field Guide to the Birds* has sold 350,000 copies in its eastern editions alone.

Dr. Peterson has traveled on four continents studying and photographing birds. In a typical year, he will be away from his home half or perhaps two-thirds of the time, either in the field or lecturing.

When Dr. Peterson is not on a bird safari or another errand having to do with birds, he may be located for brief periods with his wife and two boys in their Connecticut home. The Peterson home is situated on a 55-acre estate at Old Lyme, Connecticut, near Long Island Sound, on an eminence overlooking the Connecticut River estuary.

They purchased this home in the fall of 1954, and already their address is known to thousands of bird lovers on five continents. Their house, fittingly enough, is surrounded by a dense and bushy forest, where scores of species of birds nest and fly about in gay pageantry.

For the first eight years after World War II, the Petersons rented a place overlooking the Potomac River in the Washington suburb of Glen Echo, their home being remodeled slave quarters high on a river bluff. After years of searching, they finally decided on their present location—midway between Boston and New York.

This proved an ideal place, for

here Peterson is only a short way from the headquarters of his publishers — Houghton-Mifflin in Boston—and not too far from the headquarters of the National Audubon Society in Manhattan, of which he is now a member of the Board of Directors.

The Peterson story starts in Jamestown, New York, where Roger was born on August 25, 1908. His father was Charles Gustav Peterson from Värmland, Sweden, who came to this country at the age of four. When the family settled in Jamestown, it was virtually a Swedish community. The town lies in the hills of western New York near famed Lake Chautauqua, a district rich in wildlife. Roger's grandfather died when his father was only eleven, making it necessary for the boy to go to work in the factories and mills at an early age.

When Roger was born, his father was a craftsman in the Art Metal Construction Company, one of the city's furniture factories. Few of Roger's grade-school teachers

would have regarded him as a budding genius or a model child. He was, in fact, something of a problem, and he still holds the dubious distinction of having been spanked oftener in the sixth grade than any other boy in the history of the school. Seven times in one term he marched the dreary path to the principal's office.

But the seventh grade proved a turning point in his life. His science teacher, Miss Blanche Hornbeck, organized an Audubon Junior Club and obtained leaflets that turned Roger's attention to birds. So, at the age of eleven he embarked, in a sense, on his life's work. He still feels that his great interest in birds at that age stemmed from the fact that these winged creatures were symbols of freedom in his maladjusted youth. And he can still recall the exact date of every bird trip he made during the first five or six years of his new-found enthusiasm.

Dr. Peterson recalls with a smile that Miss Hornbeck knew little about birds but learned with the class. They studied the Audubon Junior leaflets together—leaflets that he was to rewrite and reillustrate 20 years later. Miss Hornbeck had the children copy the pictures, and Roger was launched on a career that was to win him world-wide recognition as a bird artist. He used to decorate the margins of his arithmetic and history books with pictures of eagles, hawks, and owls.

As a boy of eleven, he searched the environs of Jamestown and Lake Chautauqua for birds. He would even range along the southern shores of near-by Lake Erie—about 25 miles north—to find waterfowl. Later he wrote: "The mere glimpse of a bird would change my listlessness to fierce intensity. I lived for birds."

His preoccupation with birds did not evoke wholehearted support in the minds of his parents.

His father was a practical man and was plainly worried about his son's obsession. Roger seemed not to care how long he was away from home or how muddy or torn he got his clothes, as long as he could watch birds. Once his father stopped the boy's English teacher on the street in Jamestown and said: "Roger likes you a lot. I wish you'd tell him there are other things in the world besides birds. He'll never make a living out of them."

At other times, his father seemed to take pride in his son's knowledge of birdlore. "He can name any kind of bird he sees," he would boast to his intimates. "And he can draw them all." As the years have proved, he missed by a mile in thinking that Roger could not make a living from birds.

Training in art

After leaving high school, Roger came to New York to attend the Art Students League and also the National Academy of Design. He studied under such well-known artists of the day as John Sloan and Nikolaides. His skill as an artist is so considerable that he can draw or paint almost anything with great success, but he limits himself mostly to birds.

When the depression of the 1930's terminated his five years of

Hol H. Harrison, from National Audubon Society



▲ SEVEN MILLION CHILDREN have read Roger Peterson's pamphlets, and not a few have had the thrill of birding with him.

➤ AN INFORMAL PICTURE taken by one of his friends on a recent field trip.





▲ A STOP-MOTION photograph of Caspian Terns taken by Roger Peterson on Hat Island, Lake Michigan.

art training, he obtained a teaching position with a boys' school in Boston, where he taught natural history, art, and astronomy. He admits today with a twinkle in his eye that his knowledge of astronomy at the time was nil and that he kept just one lesson ahead of the boys all through the year. He taught in this Brookline, Massachusetts, school for four years. It was during this time that fate, in the form of a friend who was an ornithologist, intervened in Peterson's life to set him on the road to fame and fortune.

Up until this time, most books on bird identification were formidable scientific treatises, bristling with technical jargon and phraseology confusing to the layman. Peterson, who had taught himself bird identification without help, was an expert in his hobby. During his trips to New York, he took frequent bird walks with a friend he had met at the American Museum of Natural History—conservationist William Vogt (of *Road to Survival* fame). Vogt was astounded at the speed with which Peterson could identify birds and persuaded him

to write some magazine articles on this subject.

It was apparent to Vogt that Peterson had a revolutionary system, a magical short cut, as it were, to bird identification. After the magazine articles, Vogt advised Peterson to put his system in book form and illustrate it with his own patternistic drawings.

A few months later, the book manuscript was finished, but this was during the height of the depression, and first books by new authors were not easy to place. None of the first five publishers to whom he submitted it were interested. One or two of them were scornful, telling him he was a nobody in the bird field and that his book would not sell.

But the Houghton-Mifflin Company in Boston had two bird enthusiasts on its editorial staff. After much deliberation, they decided to take a flyer on the book, albeit with qualms and misgivings. They cautiously printed 2000 copies, after first stating that the author would get no royalties on the first 1000.

The book proved to be the kind

that publishers dream about. It had a runaway sale, and the first edition sold out in five days. Five thousand more copies of Peterson's *Field Guide to the Birds* were rushed off the presses. A month later they were all gone. The book had made a great hit among bird lovers, and Peterson found himself something of a celebrity overnight.

This all happened in 1934. Since then a third of a million copies have been sold, and the book has been revised twice. The last revision was in 1947, when Dr. Peterson rewrote the whole book and reworked the entire system. Now Houghton-Mifflin never prints fewer than 50,000 at a time. A companion volume, *A Field Guide to Western Birds*, published in 1941, has sold 115,000 copies. And a similar volume, *A Field Guide to the Birds of Britain and Europe*, has recently been issued in Britain. Editions of this are being published in Dutch, French, German, Spanish, Italian, and the three Scandinavian tongues. The text in these various editions may vary somewhat, but the Peterson system is the same. Since 1934, more than



Ralph Lawrence



▲ PHOTOGRAPHING a turkey vulture's nest.

➤ WILD TURKEYS in the mountains of Arizona.



900,000 copies of Peterson's books have been sold throughout the world.

His *Guide* has been so widely accepted that bird watchers simply call it "Peterson," giving rise to the quip that "Peterson has gone out with more women on Sunday afternoon than any man in history." Recently an ardent bird lover in Philadelphia wrote: "The *Field Guide* is now being called around Philadelphia 'The Gospel of Saint Peterson.'"

Interestingly enough, the Army and Navy were influenced by the Peterson system in teaching plane-spotting in World War II. In that field, as in bird identification, it served better than any other method. The system is based on shape, pattern, and the simple but clever idea of using "pointers" on recognition pictures of birds, designed to bring out the crucial points of difference.

His book showed how to spot a bird quickly and accurately from its silhouette and pattern and stressed the one or two characteristics that set it apart from other or similar birds. Gone into the discard was the need for floundering through tedious technical descriptions. With Peterson's book, the most amateurish bird watcher could not only identify a bird in an

instant but could do it at a distance. It has been called the most practical bird guide ever to appear.

This book won for Peterson a job with the National Audubon Society in New York as Educational Director. While serving in this capacity, he spent his evenings and vacations preparing his *Field Guide to Western Birds*, which covers the birds west of the 100th meridian.

Varied war work

Then came the draft in World War II. The Army gave him a job doing technical manuals at Fort Belvoir, Virginia, where he spent two years on such topics as defusing land mines and building bridges. He was assigned to the Engineer Corps to utilize his artistry for camouflage, but he was trained as a combat engineer. Toward the end of the war he was shifted to the Air Corps, where he was put to work studying the effects of D. D. T.

Before entering the Army, Roger met, in the film and photography department of the National Audubon Society, a young lady named Barbara Coulter, who was from Seattle. They were married in 1943 and now have two boys: Tory, age ten, and Lee, six.

After the war and out of the

Army, Roger and his wife made a big decision. Instead of going back to a regular job, he would try freelancing.

He rewrote the *Eastern Field Guide* and redid its pictures. He painted many birds for national magazines and illustrated a series of a dozen articles in full color, for *Life* Magazine. He prepared a "primer" edition of his *Field Guide* in a 35¢ edition, which sold 250,000 copies. He was deluged by requests for paintings and lectures.

He launched a series of bird prints, rivaling Audubon's and selling in lithographed copies for \$5 to \$15 each. He painted about 30 of them, and collectors snapped them up. An enterprising New York City department store copywriter once advertised them as "Genuine Audubon prints by Peterson."

Dr. Peterson published his *Birds Over America* in 1948 (Dodd-Mead), a 342-page book illustrated with 105 photographs by the author. This book was a great success and won thousands of new converts to the ranks of the bird watchers. It won for its author the coveted John Burroughs Medal, bestowed by the John Burroughs Memorial Association, for meritorious nature writing.

Since 1945, Dr. Peterson has made repeated trips to Europe

and has ranged all over North America, visiting many other out-of-the-way places. He has become an expert photographer, both in still and motion pictures, and he worries his budget-minded wife by his frequent investments in costly photographic equipment. One of his movie cameras is equipped with a special 12-inch Kilfitt lens. He lectures for the National Audubon Society one month each year and tries to reach a different region of the U.S.A. each time. He regards his lecture tours as a good antidote to his hermit's life in his Connecticut studio.

Sometimes people ask Dr. Peterson if scientists haven't just about discovered all there is to know about birds. He smiles patiently at such naïve questions and points out that there are about 8600 species of birds in the world, not counting subspecies. North America alone has more than 650 resident species north of the Mexican border.

"We have today only scratched the surface in our study of birds—particularly in the field of bird behavior," he declares. He places the present bird population of the U.S.A. at five to six billion breeding land birds and an unknown number of water birds. He says that the notion that man has displaced birds on this continent is open to considerable doubt. There may be fewer hawks, owls, and large game birds than in Columbus' time, but many ornithologists are sure that there are more songbirds.

Birds, he points out, are hardly creatures. They have to be to survive. And—perhaps more important—they are highly adaptable. Songbirds seem to thrive better in the broken, semiopen country that follows civilization than in virgin forests or tropical jungles.

Since World War II, Roger Peterson has distinguished himself in other aspects of natural history, al-

though ornithology is his primary love. He has edited field guides on butterflies, mammals, flowers, trees, minerals, reptiles, and other subjects. Texas, being an individualistic state, wants its own bird guide, and the Texas Fish and Game Commission has contracted with him to do a *Field Guide on Texas Birds* for an initial edition of 25,000 copies. This book will not be finished until 1957. Texas has more species of birds within its borders than any other state in the Union.

Recognition

In 1952 he received the honorary degree of Doctor of Science from Franklin and Marshall College. He is a fellow of the American Ornithologists Union and was awarded this scientific society's Brewster Medal for the second edition of his *Field Guide*. From 1951 to 1953, he served as president of the American Nature Study Society, a group composed of teachers and others who are concerned with nature study.

Around Jamestown, New York, Dr. Peterson is the shining example of the "local-boy-makes-good" tradition. They have forgotten his one-time childish pranks, such as going down the fire escape when

the dismissal bell rang in school. A year or two ago, the Jamestown Chamber of Commerce had a Roger Tory Peterson Day and presented him with a special Certificate of Recognition.

We asked Dr. Peterson about his rather unusual middle name, Tory. He explained with a smile that it did not identify him as an ultra-conservative in politics. Rather, it was a sort of special variant of the Swedish name "Thure," by which his uncle was called. When he had to tell his first-grade teacher his middle name, he could pronounce it but not spell it, and she wrote it down just as it sounded to her—"T-O-R-Y." That rendering of a good old Swedish name has stuck to him through life.

One of his close associates, Carl W. Buchheister, senior vice-president of the National Audubon Society and director of the Audubon Camp of Maine, thinks that Peterson has probably done more to promote popular interest in birds than any man since Audubon, which is quite a tribute, coming from a professional colleague.

No story of Peterson's career would be complete without an account of his record-breaking grand tour of North America. For 100 days he traveled in company with

continued on page 280

National Audubon Society



► ROGER TORY PETERSON in his Connecticut studio, surrounded by his books and writing materials.



▲ SHEPHERD FRANCOIS, a man of two worlds—the hot lowlands and the high pastures of the French Alps.

In locale, this article is something of a departure from the usual coverage of NATURAL HISTORY Magazine, but we offer it to our readers because of the lyric manner in which it portrays a pattern of human behavior as ancient as the herder's life. The author is a French-born nature writer, who received his Ph.D. summa cum laude, from the Sorbonne. During the war, he served with the French commandos. A complete book on this subject by him is soon to be published by Phoenix House, London, England.—ED.

the Big Trek

Even as in the dawn of history, the inflexible cycle of the seasons forces the herdsmen of Arles to migrate each spring from sea level to the high pastures of the Maritime Alps

By MAURICE MOYAL

THE sheep had already begun to show their ribs. They had scraped the lowland pastures bare, turning the pebbles over in their search for a last withered grass blade.

We were starting none too soon, I thought. But to the herdsmen, with whom this was a story as old as tradition, the question was also whether the 8700-foot passes would be free of snow yet. The 200-mile trek would take two weeks. Hearing them talk of the storms we might encounter, I wondered whether I could last the journey, sleeping on the ground, marching by night as well as by day, and living on the roughest sort of provender.

The plain of La Crau, in Provence, had seen the last of its winter rains, and the approach of summer would subject it to almost desert conditions. The soil was now cracking under the sun, and the sheep looked wretched in their half-starved condition.

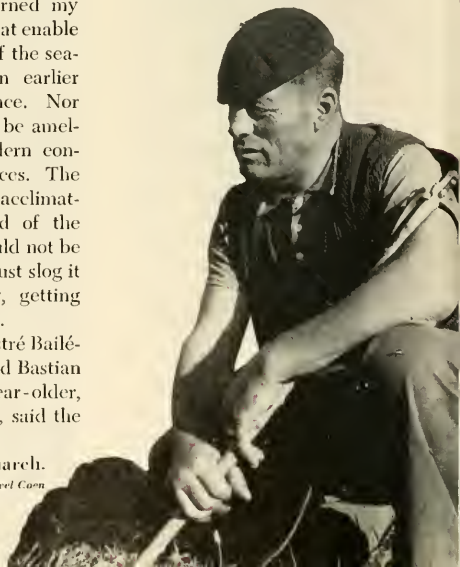
High in the Maritime Alps, where spring would replace winter almost overnight, they would be rewarded by a rich carpet of tall grass and forage herbs—if they could endure the drought and if a late snowstorm did not catch them in the passes.

Such is the schedule under which the sheepherders of La Crau must live and work. Entering upon their life, I felt that I had turned my back on the artificialities that enable us to disregard the cycle of the seasons and had entered an earlier stage of human existence. Nor could this age-old routine be ameliorated with all our modern conveniences and conveyances. The animals must be slowly acclimatized to the freezing cold of the mountain nights. They could not be carried by trucks. They must slog it out on foot all the way, getting gradually used to the cold.

And so, when Moun Mestré Bailé-Pastré—Mr. Chief Shepherd Bastian—a sturdy sixty-seven-year-old, wise in the ways of sheep, said the

migration must start, Chemin and his two helpers put the bells on the animals and away we went.

Cameraman Marcel Coen and I had to take a hand in helping the six dogs range the various groups of animals. So that the yearling lambs would be broken gradually to the trail, they were made to follow directly after the six *foucats*, the



➤ SIMON, who helped patrol the flanks during the long march.

© Marcel Coen



© Marcel Coen

▲ THE FLOCK cutting across a typical landscape in Upper Provence.

trained wethers that the flock was accustomed to follow. Next came the small ewes and young goats cutting their permanent incisors; then the adult sheep, rams, nannies, and billy goats; and lastly the platoon of pack asses.

Bastian set the animals on the trek with a sacrosanct formula:

"Brrrrr, vèni, vèni, pitchounes!" ("Now, move along, little ones!")

We had waited until seven in the evening, for most of the traveling would be done after dark to avoid the scorching heat. Bastian, accompanied by his faithful dog Lamir, half wolf and half water spaniel, was to lead the whole way, keeping the pace at a steady mile and a half an hour.

"This will be hard on you, this

gouty snail's gait," he told me, "but it's best for the flock."

In the middle of the flock, shepherds François and Simon cracked their whips and shrilled their whistles, urging their dogs to prod the sheep: "*Garçon, Brilliant, Tambour, Bazaine, Marquise, jappe, jappe, couquines!*" ("Bark, bark, you rascals!")

Jean Chemin set the rear swell in motion with: "*Ite, pitchounes!*" Unknowingly, he repeated a part of the Latin phrase uttered by Roman Catholic priests to send their flocks home after Mass: "*Ite, missa est.*" ("Go, the Mass is ended.")

Chemin and his three hired men would have to spend many a month far away from civilization and markets, and they had packed many



▲ EACH SHEEP RAISER chooses his bells so that their notes will blend to give a sound peculiar to his own flock. This bell-maker of Arles, where the sheep came from, tests one of his products with the bone of an ass.



▲ SIX TRAINED RAMS like this one and as many he-goats lead the procession. The flock will follow them.

things into the two-wheeled cart: salted mutton dried in the sun (*moutoncsso*), bacon, coffee and sugar, wine and brandy, boxes of codfish, sacks of oats for the good old mare and her colt, extra clothing, and sheep medicines. For, from where they would pass the summer beneath the shadow of the lofty 8,396-foot Cime du Voga, it would be an all-day hike even to the hamlet of Bouzieyas, population 35.

In all, there were 40 different kinds of bells, making up 4 scales, and they made a merry sound as

the animals got underway amid clouds of golden dust. Once you have heard them, these bells will always make you homesick for the trek: the flat, regular ringing of the jug-shaped rams' bell (the *redoun*), the asses' rectangular *platello*, the *pico* of the horses (one octave higher), and the silvery laughter of the dogs' tiny *clarins*, not unlike sleigh bells—all attuned to a distinctive chord, enabling an expert to identify a distant flock on the move. From afar, the ringing of a flock's neck-bells sounds like the harmony

▼ TO AVOID THE SCORCHING SUN in the lowlands and the heavy traffic, the flock is moved mainly at night.



▼ TODAY, the migrating flock encounters more difficulty than it did centuries ago. The procession averages 15 miles a day for 15 days.

▼ SIMON cooking at night. The regular diet of the shepherds is thick mutton soup, codfish roasted under ashes, bacon, and bread. The dogs eat *polenta*, a thick yellowish mush.



▼ IN A PINCH, the flock can do without water for a day, or even two, if given lush grazing. Here on the up hill climb the sheep quench their thirst from an icy torrent, fed by melting snows.



of swift-running brooks and streams.

We were an enormous torrent of animals. To the mesmerizing tune of the bells, our 2,300 sheep and goats, each fearful lest it be left behind, packed forward impatiently as tight as sardines, each allowing the one in front scarcely room to move its legs.

It was Bastian's and Lamir's job to keep the lead animals on the trail. To Chemin and his Bazaine fell the task of prodding the stragglers, while in between and on either side, François and Simon

with their dogs patrolled the flanks.

Presently, from the top of the Alpilles Hills, the peace of twilight crept over La Crau, and legions of frogs began their monotonous evening singsong. In the half light, all nature seemed permeated with a certain grandeur. Bastian lit his hurricane lamp, turning it low so as not to crack the glass. Then the yellow flame leaped and became a friendly star dancing to the tempo of the march. Words were few, as we plodded along, following a tradition that had been handed

down from father to son through a hundred nameless shepherds. These men seemed heir to a sense of continuity that stretched back to the dawn of time, and it was as though their closeness to the earth gave them something permanent in a world weary of change.

Property rights

No love is lost between these nomads and the settled folk along their route. Throughout the trek, everything revolves around an adequate supply of grass and water for the animals. This leads to an age-old conflict. Nomads view these resources as a God-given gift, free for any animal to take. The landowners, however, look at it differently. Originally, the shepherds were allowed 50-odd yards on each side of the trail. Little by little, the farmers encroached upon these roadside pastures, which were mostly on government domain. Gradually, they moved the cairns, or *mountjoio*, that marked their borders. Pitched battles were fought over these rights, and quite a few lives were lost. Some of the cairns, where the moor was valueless, still stand, but where the pasturage was good, they have long since been erased.

The code of ethics of the sheep men forbids them to damage standing crops or newly reforested areas. But when no one is watching, they are capable of turning their animals loose on fields and meadows at night. And the farmers, in turn, are quick to take advantage of the least grazing on their lands, and they will claim exorbitant damages if they can back their claims with evidence.

As an outsider, I felt that my hosts were suspicious of my motives. They seemed to wonder why I should want to share this life of toil and hardship unless I was a snooper in disguise. In their attitude I read the suspicion that I might bear witness against them if their animals happened to stray.

We marched all that night. At dawn, the black outline of a Provençal farmhouse emerged. We

© Marcel Caen



▲ SUNRISE in the Cadaraches Forest.



© Marcel Cœu

▲ THE NIMBLE RAMROUILLETS take rough terrain with ease. The shepherds worry constantly lest animals catch their fleece in a thicket and be left behind. In the foreground, shepherd Simon scolds the ill-tempered Tambour.



▲ PASSING THE STRANGE ROCKS called the Capuchines because of their likeness to hooded friars, near Les Mées.

➤ AFTER THE LABOURET PASS, this short cut along the dry bed of a torrent proved a difficult stretch.



▲ CLASHING HORNS break the peace. There is one ram for every 50 ewes. They run together all year; lambs are born year-round, though mostly in spring and fall.



▲ TRAVELING AT NIGHT, the author found it difficult to keep awake. One of the shepherds fell into a cold ditch.



were at La Samatane, our first halting place.

François ground coffee beans gipsy-fashion by rolling a bottle over them and started a fire behind a screen of cypresses. While we drank cups of scalding coffee and devoured rashers of bacon and bread, *polenta* was cooked for the dogs. They ravenously hurled themselves on this thick yellowish Indian corn mush and disposed of it in practically no time.

Without bothering to spread our sleeping bags, Coen and I were soon asleep, wrapped in shepherds' great cloaks, smelling of wool grease and wet dog. When I awoke, the sun was already high and Jean was untying the leather thongs that bound a bicycle to the side of the wagon. He was about to look for a suitable meadow for his voracious animals, and I accompanied him on my own machine. If a summer storm should catch the sheep with no more nourishment than they had in them, it might mean 50 casualties.

The Durance plain, cut by the silver thread of a river, was unrolling before our eyes like a carpet, dotted with picturesque Old World villages. After we had pedaled several miles, a farmer waved us to a halt. "Shepherds, huh? Looking for grass, huh?" He piloted us to a lush clover meadow that seemed just the thing. And it was cheap, too: only 5,000 francs.

How lucky, I thought, in my innocence. How wrong I was! The meadow was not worth a brass sou, Jean explained to me. Such green stuff, still full of water, would give the animals colic.

I would never have picked out the dry and seemingly blighted meadow he finally chose.

The sheep started to graze in a single mass, all walking in the same direction. With a noise like an angry hive, their tongues swept the widest section of grass possible, with their thin lips and almost flat jaws impatiently chiseling away. Only when their appetite had been blunted would they become more finicky and look for special tidbits.

I noticed one or two brown fleeces in contrast to the grayish color of the flock. A local ancestor, so it turned out, sometimes reasserts itself in this way. In the old days, this ancestor, like all original wild sheep, was clothed in short, coarse, straight hair, not unlike a goat's. Man's patient selective breeding had emphasized the woolly coat that we have come to think of as inseparable from sheep, so that the modern animals will produce wool that can be spun into 60,000 yards of thread to the pound. To serve his purposes, man has also developed meat- and milk-yielding species; and in the process, he has eliminated those instincts that run counter to his views. However, the more "sophisticated" breeds have lost their natural hardihood and the habit of caring for themselves. One or two breeds have, in fact, grown so dependent that, if thrown back upon their own resources, they would not survive.

A Different Climate

As the road twisted and struggled upward, we passed from lower Provence into the area of the Alps at the pass of Mirabeau. It was now no longer so hot at midday, and the sky was a tender eggshell blue. The sun touched things with a golden tint, and the air seemed lighter.

It fell to the shepherd of the watch to prepare our meals. This time François lit a big fire, and soon a big kettle was purring. He then threw into it beans, macaroni, whole potatoes, chunks of bread soaked in olive oil, some red wine for good measure, and a liberal sprinkling of salt, saffron, and pepper. If by chance some salt missed the mark, our mates would carefully scoop it up and throw it into the fire. For them, salt was endowed with a sacred character, and it would be a sin to allow it to be trodden upon.

You might not care a rap for such rustic fare as this soup, with the consistency of thick gravy. Only a ravenous appetite born of the open air and a fifteen-mile climb up steep slopes on tired legs could induce

you to put away such quantities of it as we ate.

Because the sheep men had to stay at their allotted posts during the march, they made up for their loneliness during the halts. Each would minutely describe some small incident of the day, but Marcel and I would take part in these conversations only when invited, and then briefly.

But a common task soon weaves heart-warming bonds, and ours were cemented by the companionship of the great outdoors. So we would all listen attentively to the speaker, while we methodically chewed on a goodly chunk of codfish, slowly roasted like chestnuts under the ashes of the campfire.

For love or money, Marcel and I were unable to persuade our friends to eat either fresh vegetables or fruit. They would tell us that such green stuff would loosen their bowels along the next stretch and interfere with their ceaseless watch over the flock. I imagine they must have been saved from scurvy by the milk of their goats.

Before tackling the first high passes, we rested for a whole day at Oraison. In the pure light of Upper Provence, you could already pick out ahead heights far more formidable than the lesser chain of the Alps already negotiated. The eternal snows on faraway Lure Mountain rose dazzling white above the mauve and blue Canagobie and Mallefougasse plateaus. There was just enough morning mist in the bottoms to add a touch of mysterious depth to the mountain landscape.

As we walked along the edges of the Cadaraches Forest, Bastian sniffed the air, scanned the sky, and forecast that within an hour rain would be smiting the land in a steady downpour. I thought he must have gotten a touch of the sun, for not a single cloud was in sight. Yet he proved accurate. A subtle change in the moisture of the air he had smelled provided him with the clue.

"Why don't you get the sheep under those trees?" I asked him.



© Marcel Coen

▲ TOWARD THE END OF THE TREK, salt had to be put out on the rocks to satisfy the animals' mineral requirements.



© Georgette Trizano

◀ THE NOMADS encountered many kinds of weather, from bright sunshine to sleet. Once they were hit by hailstones almost as large as eggs.

▲ IT WAS DIFFICULT to distinguish the 2300 sheep from scattered rocks in the windswept regions above treeline.



© Marcel Coen

"No, sirree," he replied. "This cool shower prepares them for the icy downpours they must endure before our journey is over."

The inflexible environment was beginning to have its effect on the herdsmen and on me. By dint of pitting our legs against the slopes, of being lashed by the mountain winds, drenched by the rains, and of lying next to the bitter earth, we were surely getting in tune with untempered nature. Our sheep, too, were getting harder and harder. At dawn, they could now graze with no ill effect on grass wet with dew, which would have been harm-

ful to them in La Crau. The combination of altitude, lush grass, keen air, and plenty of exercise had brought them into top condition. And I could see that they were reverting to their natural instincts, long suppressed in the lowland pens. When an ill-tempered dog charged a stampeding lamb with such strength that it went careening head over heels, its mother fell upon him like a whirlwind. He got the soundest butting in a sheep dog's life.

"And yet," revealed Simon, "that selfsame ewe would meekly consent to being parted from her offspring down in La Crau. The higher she climbs, the greater her motherly love."

Bastian assured me that each animal had a distinct personality. Even a twin might be as different from its brother as the waters of a torrent differ from those of a duckpond. Tempers, of course, undergo marked change at the mating season. Any September ram is an angry ram, and woe betide man or

dog that intervenes between the proud male and his lady loves. There were motherly ewes, ever ready to adopt orphaned youngsters, and there were jealous ewes.

"See that darned ewe over there?" said Bastian. "She's a nuisance. After lambing twice, she stopped bearing altogether. And now you have to watch her or she'll main another ewe's lamb."

The sheep occupied more or less permanent positions in the flock, and it was always the same lazy bodies that let themselves be carried along in the middle of the flow by the others. There were others that always went over to the sheltered side of the road when the wind changed. And certain adventurous sheep kept themselves at the fringes, at the risk of a possible nip for disobedience, on the chance of snatching some blades of grass from the roadside. On the pastures, I noticed that the animals always sorted themselves into the same groups, and Bastian confirmed this. He told me that each unit was a

family grouped around the grand-mother ewe. I also learned that the network of papillae on their bare muzzles identifies the individual as clearly as a fingerprint would. Even among inbred animals, no exact similarity in these marks has ever been recorded.

Bastian had followed each animal from its birth and was able to tell me which was the daughter of which. He had given each a descriptive name. This was partly out of fondness but partly so he could call his bellbearers when it was time to get going. Each would jog along to get fondly petted; and then, following Bastian's heels, the bellbearers would each draw along a file of their kin behind them.

Our sheep belonged to the rugged, semiferar Merino of the Arles breed. Their ancestors, the Rambouillet, were developed in the eighteenth century at the experimental farm at Rambouillet in northern France through cross-breeding Merino stock imported from Spain with a local stock. It yielded both fine wool and good mutton. Rambouillets, imported in-

to the United States in 1840, prevail on the ranges of the West.

We followed the left bank of the Durance and swung into the valley of the Verdon. In the pure light of dawn, my swim in the swift sea-green waters of that icy torrent was a joy.

A Well-Trained Dog

I noticed that the nettlesome Tambour was biting stealthily at the sheep's hocks. François sent a well-aimed stone to reprimand him.

"Why don't you file his fangs?" I asked.

"Because he's worth at least 10,000 francs, and if we did that, the sheep would soon stop fearing him. They must feel a dog's fangs at times, but their skin musn't be broken. Don't think he can bully them all he wants." The shepherd went on to tell me how the rams of a flock in the high pastures will gang up against a wicked dog and imprison him in a circle. Then with lowered horns they will gradually close in and trample him to death. François had not witnessed this, but his father had had a dog that

almost lost its life. Strangely, the animal had made no attempt to break the death circle, and François' father had had a difficult time rescuing him.

Confident now of their schedule, the men were as unhurried as if all eternity lay before them. They had cast off the calendar whereby man has sought to fragment the continuity of life into arbitrary pieces; time for them passed in even tenor. We were now following what is called the Napoleon Road, and presently a rush of traffic reminded us that it was noon on a Sunday in 1955, and we almost met our Waterloo. Cars, charabancs, trailers, trucks, and buses blared their horns, while in glaring heat and blinding dust we tried frantically to round up our stampeding flock.

Our dogs took charge with great decision, leaping on car fenders and surveying the melee like generals observing the see-saw of a battle. Snarling, howling, and biting, they somehow managed to create a narrow channel for the vehicles to drive along. Marcel and I pitched in as we could and were of some

© Marcel Coen



▲ DESIRÉ ARNAUD was six feet four inches tall and had not known a single day of illness in his 83 years. He was mayor of the village of Fours Saint Laurent, near the end of the migration.

▼ THE GOAL: three small buildings of stone amid the rich pasturage of the Maritime Alps.

© Marcel Coen



help. Hitherto, we had been looked upon as steerage passengers working their way. Now the attitude of our mates changed, and we were accepted as full members of the crew with speaking rights at the campfire.

As our procession wound higher and higher along the valleys of the Bleone, Blanche, and Ubaye torrents, over mountaintops and through snowdrifts, a number of our sheep were found to be limping. Their hoofs had gotten cracked by brutal successions of heat and cold, and the tips were worn to the quick from the rocks. Those too exhausted were put in the back of the wagon.

The hard-working dogs were also getting weary. Their paws had burst open, leaving blood-stained marks as they limped along. We were forced to do their job for

them, running hither and thither, jangling the little collar bells, which the sheep associated with the threat of a bare fang.

Despite this great fatigue and suffering, Jean insisted that up to now the trek had been a bed of roses. The "real" mountains came only when the sheep would start licking every flat stone along the way. This would mean that they needed salt, and it would be provided for them on flat stones at the halting places.

We were tackling the steep St. Jean slope when something fell at my feet, spattering my boots with blood. François leaped ahead and brought back a bolting ewe, as the flock filed past unconcerned. The shepherd picked up the living bundle, writhing in the dust, and with his broad knife, scraped and cleaned it. Presently he produced

a bigheaded, snow-white lambkin. It sought at once to stand on its staggering feet.

François tore a red rag in two, so as to mark the baby with the same sign as the mother, and promptly introduced the two. He had the ewe smell the lambkin all over so that she would recognize it by scent and allow it to suckle at the next halt. But the mother kept lamentably bleating toward the receding cloud of dust.

"She's afraid of being left behind. If her maternal instinct is slow to awaken, we'll tie her beside the lamb at the next halt." He folded the wet, innocent thing in a sackcloth and freed the ewe, which bolted at top speed toward the flock.

I was nearly played out when we reached Le Lauzet. The strain was beginning to tell on everybody,



ONE PAIR OF GRUNTS will kiss each other again and again. They approach each other open-mouthed with jaws spread

Why do fishes Kiss?

By
CARLETON RAY
Photographs by Ray-Ciampi

One of the most human-looking actions in the fish world may not have any of the meaning we humans are apt to give it

THESE Blue-striped Grunts (*Haemulon sciurus*) were photographed at Nassau, British West Indies, under 35 feet of water. Very large schools of various grunts, chiefly this one and the Yellow Grunt (*Haemulon flavolineatum*), are common in the Bahamas and other tropical waters.

"Kissing" is a frequent action among both species.

At almost any time, if one remains fairly still, several pairs in a school can be seen indulging in it. The effect is striking, because the fishes have bright red mouths and they rush at each other vigorously.

The "kiss" doesn't last more than a few seconds, but why do these fish do it in the first place?

That other famous kisser, the Kissing Gourami, which holds the

and we took a day-long rest here. I had become an automaton. At night, I would hold onto the shaft of the wagon and would every now and then fall into a doze, whereupon a sharp bump against the mare or wagon would jolt me painfully back to weary wakefulness. My companions were not above falling asleep, either. But old Bastian was so used to the trail that he would trudge along in his sleep as long as his feet were on the hard road. As soon as we encountered soft grass, he would wake up with a start. Once, Simon fell into a canal while asleep. Thereafter, to keep himself awake, he took to shedding garment after garment. He had the theory that drowsiness was caused by overheating, and he kept on taking off clothing until he finished our last two nights stark naked.

We cut across Barcelonnette by night, and it was as if a tidal wave had struck the sleeping townlet. Our bells echoed loudly in the narrow winding streets between the high-gabled old houses. The aroused dogs raised a growling concert, and the barking of ours rang out all the scorn of the free for the chained. The mating calls of our tough partwolves was a quaint mixture of appeal and defiance, which found a deep echo in many a locked-up female.

Finally, we had to climb over the last steep chain of mountains, separating the basin of the Rhône from that of the La Tinée. In the upper part of this valley our journey would end.

Before tackling the final ascent, we rested for 24 hours at Bayasse at the foot of the 8,696-foot Restefond Pass. The sheep were allowed

to eat their fill so that in the steep places they would not wander into danger in search of grass. Here the trail became a mule track, and the cargo of the cart was transferred to pack saddles on the mare and asses. The asses, with their phenomenal memory for topography, were to lead the way, which would often be shrouded in mist and clouds.

I was as heavily loaded as any pack animal. On top of my 80-pound knapsack, I carried part of Marcel's photographic equipment. Under a glaring sun, we had to climb well over 3,000 feet through a barren landscape strewn with fallen rocks and extensive snow patches.

When the trail disappeared under dense snow, the sheep halted abruptly. Thereupon the domesticated billy goats, whose long straight hair would not gather snow as would the sheep's, were goaded into taking the lead. The ewes then consented to follow.

The air became loaded with electricity, and the animals began to show nervousness as the top of the Restefond Pass disappeared under the clouds. Afraid lest the full fury of the elements should catch the flock in some narrow defile, we pushed our animals to the utmost. Fog and lightning were the serious enemies here.

As we reached a broad strategic road cutting across the pass, hailstones almost as big as eggs began lashing painfully at the animals' muzzles, and they stopped and lowered their heads. We started lashing them to have them scatter away, but they submitted passively both to our blows and the forces of nature.

"Quick, take off those hobnailed boots and throw away everything made of metal in your pocket," Marcel yelled at me.

The whole ridge began echoing with loud thunderclaps, endlessly reverberating from top to top and dale to dale. On the selfsame pass in the previous year, one shepherd and 345 sheep had been killed by lightning. I felt weak and bare and impotent, and the next blinding



scientists have thought they may not be expressing affection but antagonism.

pose longer, raises a similar question, similarly unsolved. Gouramis seem to kiss indiscriminately at almost any time, so reasons for their actions are hard to determine.

In the case of the grunts, an inkling of purpose became apparent after observing this pair for almost an hour. The kissing was not indiscriminate. The same two kissed over and over, ignoring or even chasing away others of their kind.

Though this looks very much like the well-known human form of courtship, specialists in animal behavior are inclined to doubt that it

has any of the emotional context of kissing as we know it. In fact, since the behavior exposes the bright red lining of the mouth, previous writers have indicated that it may be an antagonistic routine rather than an amatory one, possibly related to the establishment of hierarchies like the "peck order" in chickens. We cannot conclude that the "kissing" grunts are testing each other as mates. Neither can we exclude some form of courtship or territorial behavior as a possible explanation. It shows how little we know about what goes on 35 feet under the water.



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▲ THE CONICAL TOWER and a section of the ruins in the so-called Elliptical Temple at Zimbabwe.

The Riddle of *Zimbabwe*

The identity of the people who built these massive walls in southern Africa still remains something of a mystery

By PETER HOLZ



Cape
Archives

◀ A SOAPSTONE BIRD, carved by the vanished builders of Zimbabwe.

MANY remarkable and ancient ruins have been discovered in the British territory of Southern Rhodesia, but none are more massively built, more extensive, or better preserved than those at Zimbabwe. The origin of these relics of a vanished culture is hidden in the mists of time. Three-quarters of a century of speculation and investigation have failed to show conclusively who built these astonishing walls, which cast their spell over a valley fifteen miles from the end of the railroad in southeastern Southern Rhodesia.

The Zimbabwe Ruins were vaguely known to early Arabian and Portuguese explorers, but so meager was the information that when the hunter Adam Renders

reached them as late as 1868, he was considered to have discovered them.

The word "Zimbabwe" is really of Bantu origin and means "houses of stone," a name applicable to any of the 500 other smaller ruins scattered over the length and breadth of Southern Rhodesia. By custom, however, the name is today associated chiefly with the largest site.

The Great Zimbabwe Ruins may be divided into three distinct groups: the Great Temple; the Hill Ruins, which constitute a structure known as the Acropolis; and the Valley Ruins.

The Great or Elliptical Temple is now only a corral. The name is a poor one, for the building is not elliptical and it may never have been a temple. Its interior, open to the sky

like the rest of the ruins, has been much damaged by gold seekers and amateur excavators. Most striking of its features are the extremely massive outer walls, some 16 feet thick and more than 30 feet high, as well as a stone cone almost 40 feet high, indicating perhaps the religious character of the site as a whole. Like its surrounding walls, this cone is constructed of small granite blocks. It is solid throughout, as are the walls, evidence enough of its purely symbolic character.

Archeological finds at this part of the ruins have included some interesting objects such as iron bands, well-formed gold beads, and fragments of bronze bangles. Rows of dark stone are introduced into some



© Fed. Info. Dept., Southern Rhodesia

▲ Looking down into the "Temple," with some of the Valley Ruins visible beyond and at left.





▲ AN ADAPTATION of one of the carved soapstone birds of Zimbabwe appears on the one-shilling piece.



South African Railways

▲ NEATLY LAID GRANITE BLOCKS form the wall of the Great Temple. Note the double chevron design.

◀ ONE OF THE PASSAGEWAYS following the curving wall of the "Temple."

▼ MANY of the massive walls inside the "Temple" have tumbled down.

© Fed. Info. Dept., Southern Rhodesia





© Fed. Info. Dept., Southern Rhodesia

▲ THE SO-CALLED ACROPOLIS, is difficult to reach atop its rugged hill. Its main wall bore stone pillars surmounted by stone birds.

▼ FRONT AND REAR VIEWS of a bowl, whose border design some have believed to represent signs of Zodiac.

of the walls, probably for ornamental purposes, but no inscriptions or hieroglyphics have ever been found. Also lacking are any objects that could definitely be identified with any of the people of antiquity.

Suggested Affiliations

Some have claimed that the Zimbabwe Ruins are culturally linked with India, while others hold them to be of purely local origin. The ruins have at times been dated as far as 3000 years back and identified with the ancient Ophir from which King Solomon obtained his gold; and a host of authors have ascribed them to the Sabaeans or the Phoenicians. But trained archeologists were inclined to date Zimbabwe as late as A. D. 1550. How close they came has recently been shown by the Carbon 14 method of

determining age by examining organic materials. Two pieces of timber, taken from an inner wall, were subjected to this test independently in Chicago and London. Their age was thus stated without doubt to be A. D. 1361 (plus or minus 120 years) and A. D. 1252 (plus or minus 92 years).

A double chevron pattern that extends a fourth of the way around the top of the Zimbabwe Temple wall has attracted interest because it has been taken to resemble something in ancient Sabaean south Arabia. In Marib, there is a double inscription that runs a quarter of the way around one of the walls of a roofless temple as this one does just below the top.

Above the Temple on Zimbabwe Hill stands the crudely built and entirely unsymmetrical Acropolis.



Cape Archives



▲ A "DIVINING BOWL," carved from a single piece of wood. In its center is a cowrie shell. Bowls similar to this are used today by the BaVenda tribe of northern Transvaal. Archeologists have been struck by the similarities between the BaVenda culture and that of Zimbabwe.

© British Museum

▼ SOAPSTONE FIGURES. The bottom one at right is believed to represent a crocodile. Two others are birds.

© British Museum



▼ A ROSETTE CYLINDER OF SOFT STONE, found in 1889 by A. and F. Posselt. Its purpose is unknown.



© Br
Mus

▼ CLIMBING to the Acropolis

© South African Railways





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▲ Those who built Zimbabwe's Acropolis made clever use of existing rocks.

Man-made walls are cleverly blended with giant boulders here; they are not entirely plumb and vary in width from place to place. No written characters have ever been found in the entire site; the people who built here seem to have been unacquainted with writing of any kind. More than 1000 ounces of gold ornaments have been taken from the ruins since their discovery almost a century ago. In the Acropolis itself, iron spearheads, daggers, rings, axheads, and pots have been found. Innumerable pieces of gold wire, bronze bangles, colored glass beads, and objects indicating phallic worship have been unearthed over the years. Some of these objects are now housed in the Queen Victoria Memorial Museum in Salisbury and in the National Museum in Bulawayo.

Zimbabwe Hill, on which the Acropolis stands, rises a little more than 200 feet above the Temple but is very steep and barely accessible.

On the surrounding walls of this enigmatic structure, strange pillars of soapstone once stood, surmounted by beautifully carved figures of birds. None of these remain in place, but some of the carvings have fortunately been recovered from near-by native dwellings and can be seen in the Museum of Cape Town, at the southernmost tip of the African continent. These birds currently provide the motif for the crest of the Rhodesian coat of arms, as well as for the one-shilling piece.

Vandalism

Early treasure-seekers did considerable damage, and the ruins have also suffered from inevitable deterioration. Restoration work has been carried on from time to time, in accordance with the original patterns wherever possible. From the abundance of worked gold in various forms and fragments of crucibles used for smelting, it is evident that Zimbabwe was intimately con-

nected with the ancient gold-mining industry. It may have been a collection center for gold and other merchandise, such as slaves, for it is only 230 miles to the greatest medieval port of east Africa, Sofala.

The Ruins have not as yet been completely excavated, and there is still hope that future investigations may solve the riddle of Zimbabwe. The Valley of Ruins, situated between the Elliptical Temple and the Acropolis, is the most promising spot, for this area has not as yet been fully explored. These Valley Ruins consist of small buildings, perhaps the dwellings of the traders who bartered the gold brought in from distant mines. This portion of the site has given up its share of phallic emblems, reminiscent of ancient Greece, as well as carvings of hawklike birds, gold objects, and strange bowls. Rider Haggard, the author of the famous novel *She*, made this valley the "dead city" of his well-known story.

smooth mass of floating ice I had ever seen. The level top of the island stood 30 feet or so higher than the surface of the pack ice. From this, we calculated that the island must be 200 feet thick.

Ahead was the shadow of our B-29, alarmingly close. On each side stretched an unrippled plain, looking very much like a vast skating rink. In the midst of the excitement, Captain Bloom reminded us: "Take a good look while you can. We won't have enough gas for another run."

Perhaps the extreme smoothness of T-2 can be attributed to melt-water becoming inpounded in the "furrows" during the summer months and later re-freezing. Progressive melting and freezing might thus tend to level the surface. Further flattening might be produced by sand-blast action from driven snow. All this, of course, would take time. But it may mean that the smoother "ice islands" are those that have drifted around the Polar Basin for the greatest number of years.

Photographs of T-3 show it to be rougher and even more corrugated than T-2. Possibly, T-3 has come from a different sector of the Ellesmere shelf or from another source; or perhaps it is only of more recent vintage.

As we skimmed over the surface of T-2, I could see no water in even the deepest depressions. Its lack may be explained by the fact that this island is farther north than T-1, farther from the warming influence of land.

I was convinced that a wheels-down landing would not have been difficult, and in fact that a wheels-up emergency landing would have had an excellent chance of success. A smooth runway of any length could have been selected in almost any direction.

As I quipped, half-jokingly, "Let's drop the wheels and set her down," I may have influenced our pilot, because he brought the huge

bomber in even lower. In fact, the rubber end of our trailing antenna struck the ice and ripped off, to provide proof of our visit and perplex any future party that comes to explore.

It took six and half minutes by stop-watch to pass over the middle of the island from side to side, making it 21 miles across and at least 300 square miles in area.

As we roared over the island's farther end, a large seal slithered off a fringing scarp and splashed into the water. Of course, my movie camera chose that moment to jam, but the sight served to remind us of Stefansson's contention in his book *The Friendly Arctic* that a good hunter need not perish in the far North. Although a slightly reassuring idea in case of an emergency at this high latitude, we hardly wanted to put it to a test.

We longed for a more studied view of our island, but the navigator's word this time was adamant: "We're heading home," he said. "I hope we make it; there's still 1900 miles to go." Then with octant in hand, he climbed up into the astrodome for another sunline to check our position.

Major Koenig leaned back in his seat in the nose of the Fortress, and we climbed to 10,000 feet. I also tried to find a more comfortable position. There is so little spare space in the control pit of a B-29 that I found it difficult without pressing against some important-looking instrument handle or other protruding mechanism. To give us more freedom, Dr. Moore crawled aft along the fuselage passageway to where he could stretch out full length in the roomier rear compartment. It was our first relaxation in more than 14 hours.

For the first two hours of our homeward flight, we were in sparkling sunshine. I sat in the nose, writing notes and scanning the ever-changing pattern of floating ice. Our four smoothly churning propellers made me think of the

epoch-making flights of Eielson, Wilkins, and Byrd. How differently they must have felt with only one small engine to keep them aloft.

Soon we encountered increasing amounts of mists. Whenever the navigator needed a new fix, we would climb up into the sunlight. Then at 2 A.M., a solid wall of clouds closed around us, and for the next four hours the engines drummed a steady beat in a seeming vacuum of milky nothingness. It was not until 6 A.M. that we broke out of the murk. Captain Bloom advised that we were approaching the Alaskan coast but that there was not enough fuel to reach Fairbanks or even Point Barrow. In consequence, Captain Bass turned eastward for Barter Island, where there was a small emergency landing field only 4000 feet in length. Since this landing strip had always been considered too short for a B-29, the crew of the small Naval Radio Station there were mighty surprised to see us. They were even more surprised, however, when they learned where we had come from. Our 20-hour non-stop flight was the longest Ptarmigan mission in the squadron's history of more than 500 polar flights. A welcome breakfast of sizzling bacon and fresh eggs was spread out on a huge table. While we ate, gasoline was pumped from 55-gallon drums into the aircraft's hollow tanks.

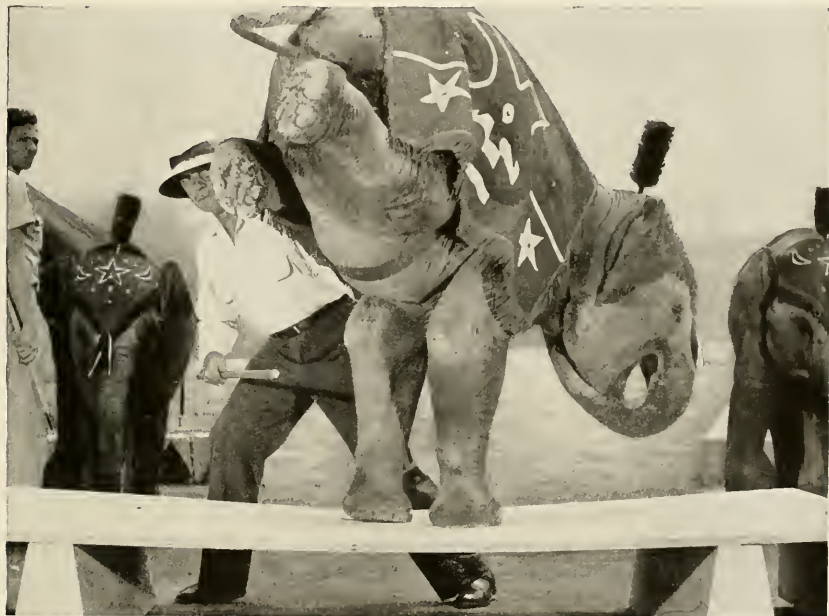
A few hours later, we were cruising over the Brooks Range toward Fairbanks in brilliant sunshine. There had been no night on this flight, and I had been too excited to catch much sleep. When the let-down finally came two hours later at Eielson Field, all of us knew we were completely exhausted. Yet the pilots calmly landed the ship just as if they were coming in from a routine training flight instead of a memorable 4100-mile journey beyond the Pole.

Eight months later a dramatic phase in the scientific exploration of the Polar Basin took place. On

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March 19, 1952, a ski-equipped, twin-engined aircraft flown from northwestern Greenland, made a bold landing on T-3, which by then had drifted to within a hundred miles of the Pole. On board was Colonel Fletcher, with General Old serving as co-pilot. Colonel Fletcher and two companions remained on the island for 13 days to assess the possibility of setting up a permanent camp. Additional personnel, supplies, and equipment were then flown in to establish a year-round station for weather and geophysical observations.

"Project Icele," as this expedition was called, initiated detailed studies of this wedge-shaped island of ice and of the ocean floor over which it floats. The objectives embrace a broad range of field research, which will greatly increase our knowledge of arctic meteorology, oceanography, and glaciology. For stimulating this program, the greatest credit is due Colonel Fletcher and General Old, both of whom showed inspiration and vision in pushing forward the initial landing at a time when circumstances were much against the project's success.

Ground parties are now unraveling various problems concerning the development and nature of these strange ice bodies, and much information of interest has already been gathered. One question not yet answered is how long the islands have been drifting around.

We do know that climatic conditions have changed markedly in recent times. At the height of the glacial period, the pack was vastly more extensive than it is today. Heavy sea ice filled the ocean and extended well up into the fjords of all the bordering land. Several times since the last maximum advance of the Pleistocene glaciation about 10,000 years ago, the Arctic Ocean has been almost, if not completely, an open sea. The first such condition is suggested by the strong retreat of land glaciers in the warm era known as the "Climatic Optimum," which occurred some 5000 years ago. This

was followed by another temperature fluctuation, culminating in a colder condition at the beginning of the Christian era. Further evidence suggests that in the fifth and seventh centuries, the seas in the summer months were clear again as far north as the Pole and that probably their peripheral waters remained relatively free of ice on up through the tenth century when Eric the Red and his son Leif were voyaging to the New World. The records of Norse settlers reaching Greenland for 300 years after 983 A.D. suggest that the climate was relatively milder up until the fourteenth century. Then, two to four centuries ago, there was a worldwide expansion of glaciers and a thickening of polar ice in a new "Little Ice Age." At that time, the shores of the arctic basin had much more land-fast ice than they do today, and ice must have been especially persistent along the coast of Ellesmere Island. But now, the pendulum is swinging back, and the glaciers and sea ice are again diminishing.

The present appearance of the Ellesmere ice-shelf suggests that its break-up has been hastened since the turn of this century and probably even since the time of Nares' distinguished voyage of eighty years ago. Recent European studies have shown that the pack may have thinned about 40 per cent since 1895. Meteorological records also show that a climatic change of world-wide significance has warmed the earth an average of 2 degrees F. since 1885, resulting in a rise in the winter temperature of more than 11 degrees F. at the latitude of northern Ellesmere Island. Considering these facts, it may be that the sea ice is no longer continuous enough for a sledge party to travel across it to or from the Pole as Peary did in that memorable spring of 1909.

With the ice islands to serve as bases for scientific parties, our knowledge of the arctic basin can grow apace. A lot of work can be carried out on them before they melt, unless I miss my guess.



Mira Atkeson



Arthur Frack

Mighty mu-hroom (left) and milkweed (right) demonstrate a force that can crack skulls, split rocks, and sink ships.

Vital Force?

Sirs:

The blacktop paving through which this mushroom had forced its way had been laid for at least 18 months and is supposed to be 4 inches in depth. It seems amazing that so frail a plant should have this power. Is any explanation known?

MIRA ATKESON

Portland, Ore.

Several readers have made similar inquiries after viewing the accompanying picture of a milkweed plant bursting through an asphalt road in our October 1955 issue. Dr. Jack McCormick in charge of vegetation studies at the American Museum has compiled the following explanation:

This poses a challenging question, but I don't believe that there is any reason to read into this phenomenon "an illustration of the power of the life impulse," as one of your readers suggested. It is, rather, a simple physical phenomenon of imbibition. This is not a process peculiar to living matter as some of the following examples will show.

Myer and Anderson state in their *Plant Physiology* (1939), "Pressures, sometimes of an enormous magnitude, develop during the swelling of an imbibing substance. Such pressures only become evident if the imbibant is confined in some way during the process of imbibition."

Oran Raber, in his *Principles of Plant Physiology* (1933) mentions that, "The forcing apart of the bones of the skull by inserting swelling peas and then adding water is a common practice in anatomical work. Boats have been known to split apart when leaks permitted the entrance of water to a cargo of rice or beans, as in the case of the motorship, *Rhineland*, in 1926."

In the *Textbook of Botany*, by E. N. Transeau and others (1940), we are reminded that "before the discovery of explosives, stone was quarried by pouring water upon pieces of dry wood that had been wedged into holes drilled in the rock. Even at the present time this method is used in quarrying marble and granite for special purposes."

The power of growth is also demonstrated in some cases of plants performing herculean tasks, and again this is a physical process combined with a biological process. Both imbibition and cellular reproduction are concerned in these examples, cited from an article in *The Youth's Companion* of August 28, 1890:

About 1890 the Massachusetts Agricultural College measured the expansive force of a squash during the process of ripening. "When about half grown, the fruit, still connected with the vine, was placed in a wooden cradle, and to the upper surface was fitted a basket-like framework of iron bands riveted together.

"As the squash enlarged, the framework was pushed against a stout beam, arranged as a lever and weighted at regular distances. In spite of all this harnessing, the squash steadily enlarged, from August 21st to October 31st, raising with perfect ease the weights which were added from day to day.

"From sixty pounds on the first day, the burden was gradually increased to over two tons, and the squash continued to grow. Under a pressure of 5000 pounds the iron framework broke, and so brought the experiment to an end—leaving it in doubt whether with a stronger harness still greater power might not have been displayed."

When I was a boy, I remember that our grade school science teacher suggested that if we were ever angry at a cement contractor, we might get even by dusting his wet concrete with fungus spores. The later growth of the sporophores of the fungus will play havoc with a concrete sidewalk. I never tried it, but it sounds reasonable.

Jumping Peas Too?

Sirs:

The article on Mexican jumping beans in the February issue of *NATURAL HISTORY* reminded me of a little animal your readers may be interested in. He is the pea weevil, and although apparently unrelated to the insect in the jumping bean,

he is very capable of making an infested pea jump just as respectably as the Mexican bean.

I became acquainted with him while working part time at a grain elevator in Eastern Washington while attending college. Dried peas are stored in elevators similar to wheat, and infested peas will show a good deal of movement at certain times of the year. In some areas, infestations can become so complete that from 30 to 90 per cent of the pea crop is wormy and unfit for consumption.

I have enjoyed *NATURAL HISTORY*, I would like to add, for the past eight years; I was introduced to it in a course at Washington State College, where it was used as a text.

CHARLES M. REED

Tacoma, Washington

One authority on the subject, Dr. C. H. Curran, Curator of Insects and Spiders at the American Museum of Natural History, has this to say on the subject:

I do not recall any records of peas "jumping," but there is no doubt that infested peas can roll about due to the movement of the weevil larva. As in the case of the "jumping bean," a little extra warmth will stimulate the larval activity and cause the peas to roll. In very heavily infested peas in an elevator there could be observable movement of the peas, especially when the adults are emerging beneath the surface layers. Dr. Reed's observations are most interesting and might well lead to research on the jumping potentialities of the pea weevil.

Beans Again!

Where can one buy "jumping beans?" In answer to this query from several readers we give the following address: Quivira Specialties Company, 4204 West 21st Street, Topeka, Kansas. The price is approximately \$1.00 for thirty-five.

Weather or Gopher

Sirs:

Readers of "The Mystery of the Mima Mounds" (*NATURAL HISTORY*, March, 1956) may conclude that the origin of the mounds by frost action is a widely accepted fact. However, those who wish to weigh the arguments in favor of the

theory attributing them to the work of pocket gophers will find the evidence presented in a contribution from the Soils Department of the University of California: "The Origin of Mima Mound (Hogwallow) Microrelief in the Far Western States," by R. J. Arkley and H. C. Brown, in *Proc. Soil Science Soc. America*, 18(2): 195-199 (1954).

Proponents of the gopher theory do not underestimate the importance of weather and vegetation as indirect agents in the mound-forming process. They do, however, feel that the singular geographical distribution of the mounds favors the gopher theory rather than the frost action theory. They further believe that the spacing of the mounds is an expression of gopher territoriality and that the mound itself is an expression of gopher industry.

VICTOR B. SCHEFFER,
Biologist

U.S. Fish and Wildlife Service,
Fort Collins, Colo.

Noisy Eel

Sirs:

You have on various occasions described the sounds made by different animals, and I would like to ask a question.

Back in the spring of 1930 a friend and I were gigging frogs in Fourche Creek Bottoms, Arkansas, when we saw a large lamprey eel in shallow water. My friend gipped the eel, and as he lifted it from the water, it gave three sharp cries similar to the cries of a rabbit when it is caught. This weird and unexpected sound startled both of us, and we have been wondering ever since whether this is a common habit of eels.

W. CARL MARTIN

Little Rock, Ark.

The following answer is offered by Dr. Marie Poland Fish, Biological Oceanographer at The Narragansett Marine Laboratory:

I am unable to find other observations of lamprey sound in the available literature, and the fish is not one of the more than 200 different species we have auditioned to date. However, I am not surprised at this report, for we are finding that there are more sonic than silent fishes in the sea!

The lamprey eel (*Petromyzon marinus*) is a much more primitive species than the common or American eel (*Anguilla rostrata*), but perhaps the data we have on the latter may give a clue to the lamprey's potentialities.

In the course of our experiments, the common eel has demonstrated two types of biological sound: first, dull thuds or thumps, produced singly underwater, with a frequency spread of 25 to 1200 cycles, and secondly, long continued low clucking which resembles the "put-put" of an outboard motor, clicking and squeaking.

The latter bubbling "put-put" noise, although audible on many occasions in the air, was never recorded underwater. This sound is apparently the "bruits de soufflé" reported by Dufosse in 1874, and probably the "distinctly musical" voice of the eel mentioned by Abbott in 1877. As described by the latter, a single note, with slightly metallic resonance, can be heard only after dark and sometimes on wet nights during overland migration, when the sound may resemble the "faint squeak of a mouse."

From Mr. Martin's short description, I imagine that the lamprey's "three sharp cries" in the air were somewhat similar to those of the common eel, which were incited by any disturbance such as motion of the container, slight prodding, or even loud noise. A "cry of alarm" is common among sonic species.

America Beautiful Contest Winners

In the contest for original poems about our national parks the following prize winners have been announced:

FIRST PRIZE—Florence Burrill Jacobson for her poem entitled, "Acadia National Park," (Maine), (\$100.00)

SECOND PRIZE—Roland English Hartley for his poem entitled, "Our National Parks," (\$50.00)

THIRD PRIZE—Charles B. Shaw for his poem entitled, "Proud Inheritor," (\$20.00)

Booby Trap

As one of our readers noted, a man-of-war bird having its picture taken, was incorrectly identified as a booby, on page 142 of the March 1956 issue.

YOUR NEW BOOKS continued from page 231

sumably those with photogenic possibilities. There are wide gaps if the reader is expecting anything like an encyclopedic introduction to the living world. Flowers, insects, reptiles, birds, and mammals all receive attention, but the approach is through "animal children," "life in the Everglades," "camouflage in nature," "inventions in nature," and similar specialized circumstances.

Because the intention is to feature the

wonders of nature, grouping the examples under these special headings is perhaps an effective introduction, but the selection of the wonders themselves, and the omission of others, follows a random pattern that can only be reconciled by the availability of photographs. The full subject of "Nature's Wonders" has not been very deeply explored by this book, and there are obvious journalistic strivings for effect. An instance of this sort is the chap-



ter "Inventions in Nature," which is filled with distorted connotations of familiar terms to imply that nature operates in anthropomorphic fashion.

HAROLD E. ANTHONY

WORLD BOOK OF GREAT INVENTIONS

----- by Jerome S. Meyer

The World Publishing Co., \$3.95
270 pp., illus.

THIS is a fascinating volume for anyone with an interest in mechanics, for it discusses and illustrates the history of important inventions. An ample subject such as this would require a long series of books to do it full justice, but the author manages fairly well in the confines of 270 pages. Inventions of mankind through 100,000 years to the Renaissance are disposed of in the first

38 pages. Perhaps this is just. The very difficult inventions of early human history appear absurdly simple when viewed from present-day perspective, with all of our inherited knowledge and techniques.

Meyer divides recent mechanical history into the Mechanical Age, the Internal Combustion Engine, and the Age of Electricity. With some detail and interesting illustrations, he recounts the stories of printing, optics, the typewriter, the sewing machine, and photography. Under the second heading he groups the histories of the gasoline engine, the automobile, the diesel engine, and the story of flight, including the airplane and jet and rocket propulsion.

Under the Age of Electricity is recounted the histories of the discovery of electricity, development of generators and motors, the telegraph, telephone, and vacuum tube. The description of these developments, step by step, in simple language, surprises the reader into realiz-

ing that now he actually understands how and why his car engine, radio, television set, and telephone operate. An appendix lists other brief sketches of inventions in alphabetical order. Even such an important development as the water closet is not neglected in this listing; it follows immediately after the history of the development of the transistor.

This will be an excellent book for teenage youngsters with some interest in mechanics and science. If this review must end in a carping tone, it would be this: in these histories inventions are presented as original creations of an individual or a small group of innovators. In invention, as in politics, it may be argued that the times and cultural level make the man, which is rather well demonstrated by the number of independent, simultaneous inventions. If Watt had not worked out the principle of the steam engine, who can doubt that it would have remained unknown?

JAMES A. FORD

THE BIG TREK *continued from page 267*

crash did nothing to ease my mood, for the lightning struck the top of the pass a few feet above our heads. A blue tongue of flame darted in the wake of warm air created by the close huddle of the sheep. Scared almost out of their lives, they scattered like chaff before the wind.

Despite our pounding hearts and bursting lungs, Marcel and I ran like mad in our stocking feet to round up the terror-stricken animals. There was the risk of falling over a precipice concealed in the fog. "First, the trained rams!" shouted someone, somewhere.

I pricked my ears for the deep sound of the rams' bells, but the fog deadened all the pitches to the point of making them sound alike. By good chance, I caught hold of an all-important ram by two of the

three tufts of wool that are left unshorn on its back for this purpose. Despite its fierce butting, I shook its bell as if my life depended upon it.

Suddenly, the north wind began blowing, wicked and with a whip-lash in it. The fog cleared away like a routed army, and soon to the right and left all the bells of the other leaders started echoing together. This eventually recalled the scattered ewes. Everyone was wondering how many casualties there might have been.

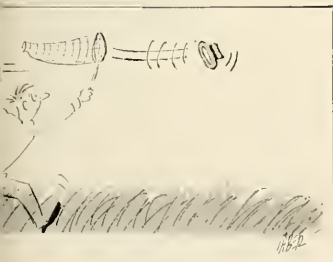
I had thought that the ordeal would be over with that steep climb, but under a steady drizzle of sleet, the descent to the Camp des Fourches pastures, 1500 feet below, was almost a worse experience. The descending mule track had been converted by the storm into a muddy torrent, and I was soon covered with sticky clay. It was difficult to keep from going too fast, and I often simply tobogganed. Yet the others were continually getting ahead. Never in my life have I felt so miserable and lonely, and I think it was in this moment that I came closest to understanding what the herd instinct must mean to the sheep.

At long last, rounding a bend,

we emerged into a vast circle of lofty mountains, topped by the dazzling whiteness of the eternal snows. Two foaming torrents, leaping in a succession of rainbow cascades, enclosed a landscape of such soul-stirring beauty that I all but forgot my bone-weariness.

At mid-slope on the Cime du Voga, we could see ahead three small cabins, built of unhewn stones and with roofs nearly touching the ground. The largest was the shepherds' cabin, the remaining two, the stables for the pack animals. The sheep and goats had to be content with an open corral near by.

Half-frozen and drained to the limit of my strength, I fell rather than sat upon a stool in front of the cabins. Hot coffee and warm food soon revived me. The sheep and goats had already hurled themselves upon the rich, sweet grass and succulent herbs, without showing any memory of their recent fright. We must have lost quite a few animals in the mountains, but any sense of bereavement seemed forgotten in the bounty of the moment. We had made our goal, completing one more turn in the cycle of the seasons by which life is so closely bound to a more primitive era in this part of the Alps.



the distinguished British birdman James Fisher (described as Peterson's "opposite number" in Britain and Europe). The idea arose because James Fisher had left no stone unturned in assisting Peterson in his European travels and in his writing on Europe's birds. They had collaborated on some work, and a firm friendship had sprung up between them. So in the early 1950's, Peterson planned a tour for his friend. He felt it highly desirable for some opinion-making

European to see the full grandeur of North America, and especially our conservation work and wildlife management. The trip was a sort of "ambassadorial gesture," as Dr. Peterson puts it, to enable James Fisher to interpret a different phase of America to Europe than the average European gets on a trip to America.

The outcome was the now-famous 100-day tour. It commenced on April 10, 1953, when they met in Newfoundland. It ended in mid-July, when James Fisher left his friend in the Alaskan area and returned to Britain. It has been said that not even John James Audubon in all his lifetime covered as much of the North American wilderness as did Roger Tory Peterson and his distinguished English colleague in those 100 adventurous days.

A little over a century after Audubon, and partly tracing his trail, they started in Newfoundland and went south along the Appalachian highlands to Cape Sable and the Dry Tortugas, America's coral islands. They then struck west and south into the cloud forests of Mexico. Passing over the continental divide and deserts to the Coronado Islands, they traveled up the entire length of the Pacific coast to Alaska, where their journey reached its climax in the Pribilofs. There they saw the 1,500,000 fur seals of the fabulous seal islands.

Fisher covered in all some 30,000 miles. The two naturalists made the trip by car and plane, driving in Dr. Peterson's station wagon in most of continental United States and Mexico. They probably covered more wild country of North America in a single trip than anyone has ever done before.


The voluminous notes that both men took on this trip finally metamorphosed into a fascinating, profusely illustrated book entitled *Wild America*, written by them jointly. It was published early last autumn and received prominent notice in the book and scientific

world. Both the *Chicago Tribune* and the *New York Herald-Tribune* featured it with page-one reviews, and it has been a best-seller in its field around the country since. This 434-page book is illustrated by scores of drawings by Roger Tory Peterson—wild animals, reptiles, forests, mountains, trees, Eskimos, and plant life, with, of course, more birds than any other category. It is the kind of book that could scarcely have been written prior to our era of airliners and superhighways.

Anyone who gets to know Dr. Peterson cannot help but be struck by his almost boyish enthusiasm for his work. He embarks on every field trip with all the ardor of a sort of super boy scout, and every trip is a new adventure, every day brimming with fascination. Yet this enthusiasm for birds and birdlore has nothing sentimental or immature about it. It is rather the manifestation of a deep-seated love of occupation, too often missing in adults, the passion of a man whose vocation in life is also his avocation.

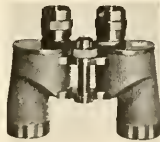
He loves nature in a philosophical way, yet he sees natural phenomena in a lucid, objective, and realistic manner. He has a gift for expressing his feelings about nature in a simple, forthright style. His writings for children have been especially successful. Most of his books are illustrated with his own photographs or drawings. Dr. Peterson likes to be with children and will let formal appointments wait while he talks to a teenager about the wonders of the outdoor world. Seven million children have read his pamphlets in the Audubon Junior Clubs.

Dr. Peterson is a man of genuine humility and his honors have never changed him a bit. What better testimony could there be of the influence that the world of nature can have on the personality of one who has become absorbed with its beauties and mysteries?



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The World of Fishes

by **William K. Gregory and Francesca LaMonte**. A survey of the biology, habits and history of fishes. Gives interesting facts about hundreds of different fish, from 400 million year old Ostracoderms to present day species. Charts and over 100 photographs. 96 pages. \$1.53

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by **Harry Tschopik, Jr.** Tells about the head hunters, poison blow gun users and other tribes in the tropical jungles of Peru. How a primitive people live in one of the most remote areas of the world. Illustrated with photographs. 24 pages. 80¢

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by **Harry Tschopik, Jr.** Surveys the origins, languages and culture of the North American Indians. Describes the patterns of life of tribes typical of various regions—the pueblo dwellers of the Southwest, eskimos of the Arctic, nomads of the plains and tribes of the East and West Coasts. Many photographs and drawings. 64 pages. \$1.50

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Letters

The Caterpillar and the Butterfly

SIRS:

I enjoyed very much your photographs of the metamorphosis of the *Papilio* butterfly in your April issue. It is a process I have watched on several occasions. But I would like to call attention to what I believe is an error in captioning. In reference to the photograph showing the insect in the chrysalis stage, it seems incorrect to imply that it has now encased itself. The caterpillars of butterflies do not enclose themselves in a cocoon of silk but only attach themselves to the stem by a silken strand, and they reach the chrysalis stage by shedding the skin. Or am I wrong about this particular butterfly?

FRANCIS BOWDITCH WOODFORD, M.D.
Ridgefield, Conn.

Dr. Woodford is correct. The caption

was misleading in that the caterpillars of *Papilio* butterflies, as distinct from those of the moths that spin silken cocoons, only attach themselves to the stem by a loop of silk over the body and by fixing the tip of the abdomen to a "button" of silk at the hind end. They then shed the skin, and as it splits from the head-end backward, it dries and shrinks, finally

dropping to the ground, while the loop and the abdomen hold fast to the stem.

The finding of a chrysalis that lacks the silken cocoon does not, however, carry assurance that a butterfly will emerge, for most of the moths likewise lack this. A much better indication is in the fact that the chrysalis is lodged above ground. Most of the caterpillars of moths go underground for this transformation. — Ed.

Important Notice

Readers are reminded that **NATURAL HISTORY** is not published during July and August. Those who expect to be away after September 1, however, and wish to have their September issue sent to a temporary summer address are requested to notify the Circulation Manager. Please give also the date of expected return to permanent address.

Rare Sea Serpents?

SIRS:

I always read **NATURAL HISTORY** with great interest, but I was particularly interested recently in one story — "An Australian Sea Serpent" (January, 1956). I should like to take exception, however, to the statement that narfish have not been seen in Australian waters since 1947.

continued on page 334

NATURAL HISTORY

The Magazine of the American Museum of Natural History

Bringing you the best in scientific thought and opinion in exploration, research, and the world of nature

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June, 1956 Volume LXV, No. 6

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THE COVER THIS MONTH

There is no living thing more comely or lovable than a baby deer. This little blacktail deer of western North America is in the white-spotted livery typical of fawn-deer.

May and June is the time when the doe steals off alone to some quiet place to have her young. Only one fawn arrives if it is her first baby, but usually there are twins in later years and sometimes even three.

For the first three or four weeks the little ones lie hidden in dense foliage or long grass and remain perfectly still until the mother comes to suckle them. Their spotted coats are most beautiful during these early days, and the spots look exactly like patches of sunlight shining through foliage on a brown background. As the coat gets longer its beauty fades; and by September, when the fawn has taken to following its mother, the spots have become a dull drab gray. In October, the mother sheds her bright summer suit for one of clear dark gray and the little one steps out of its polka dot garb and dons the newest fall styles.

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PSYCHOLOGY AND BEHAVIOR OF CAPTIVE ANIMALS IN ZOOS AND CIRCUSES

----- by Dr. H. Hediger

Criterion Books, \$6.50, 166 pp.

BEFORE the time of Darwin, the minds of animals and men could scarcely be mentioned in the same breath. Man had intellect and will. Animals were the slaves of brute instinct. But with the rise of evolutionary doctrine its followers considered it necessary for the support of their theory to show that man and animals had many features in common. This led to the establishment of the science of comparative psychology, the study of which Dr. Hediger strongly advocates, pointing out that especially in zoos, the points of similarity of behavior on both sides of the railings are too obvious to miss.

It is not only the comparisons between animal and human behavior that are of interest, but also the tremendous impact man has made in recent years on the lives of animals. "Nowadays, practically all animal behavior is directly or indirectly influenced by man." Many of these influences are indirect, as for example when forests are cut down or fields are plowed, but the most direct influences of man are seen among domesticated animals and among wild animals in zoos and circuses. These are the subjects for Dr. Hediger's sharp eyes and keen analyses, for as Director of the Zoological Gardens of Zurich, Switzerland, he has had ample opportunity to study the behavior of zoo animals, and to make comparisons with their wild relatives during his field studies in the African jungles.

Wild animals are ever on the alert, ready for escape. Yet a flight reaction is not initiated whenever an intruder is sensed. It is only when the enemy comes within the flight distance characteristic for each species, that flight follows. Domestication reduces alertness and the flight distance, but these are modified to a considerably lesser extent in zoo animals. This is exemplified by the author's efforts to study sleep behavior in elephants. The slightest disturbance made by a human will wake a sleeping elephant. On the other hand, a neighboring elephant may rub and poke his neighbor severely without causing the latter to stir.

Study of the training program of circus animals is valuable because of the insight that this procedure gives into the social organization of animals. The trainer becomes in effect the dominant member of the group and is able to maneuver his subjects as a result of this leading position in the social hierarchy. The fact that an

animal is successfully trained does not mean that it has superior intellectual capacities; rather, it represents an emotional adjustment between trainer and animal.

These are but a few examples of the many excellent observations and discussions which should give this book high priority on the bookshelves of all naturalists and students of animal behavior. The translation from the German by Geoffrey Sircom is well done, the style is smooth and pleasant, the book is replete with fine illustrations, and technical errors are few.

LESTER R. ARONSON

EVOLUTION, GENETICS, AND MAN

----- by Theodosius Dobzhansky

John Wiley, \$5.50.
398 pp., 109 illus.

GENETICS IN THE ATOMIC AGE

----- by C. Auerbach

Essential Books, \$2.00
106 pp., 46 illus.

THEODOSIUS DOBZHANSKY has long been recognized as a great leader in evolutionary genetics. His *Genetics and the Origin of Species*, is the most important single work on genetical aspects of modern evolutionary theory, but it is too technical for the beginning student or the general public. Now Dobzhansky has produced a broader study of the whole subject, an introductory college textbook which does not demand previous technical knowledge of the reader.

Most of the essential aspects of evolutionary fact and theory are summarized, although emphasis is placed on genetics, as the title indicates. The presentation is so clear and well-rounded that this work could serve as an introduction to genetics in particular, and to evolution in general.

Dobzhansky's new book can be profitably read by anyone with more than a casual interest in this vital subject. There is, for instance, a sensible discussion of the races, as well as a concluding chapter on "Chance, Guidance, and Freedom in Evolution." Helpful illustrations, annotated reading lists, and a good index enhance its value.

Auerbach's little book is hardly more substantial than a full-length magazine article. Although the reader is invited to go on to more detailed treatments, none is cited, and there is no index! The illustrations are mostly rough sketches, which are often humorous.

An extremely simplified introduction to genetics is given, with emphasis on mutation. This is followed by a brief consideration of the harmful genetical effects of nuclear radiation. There are no firm conclusions, but one must agree that none is yet possible and that this book painlessly presents the very least that the man-in-the-street should know about one of the most serious and least understood problems of our time.

C. G. SIMPSON

THE DESCENT OF PIERRE SAINT-MARTIN

----- by Norbett Casteret

Philosophical Library, \$4.75
160 pp., 2 maps, 21 photos

EACH August from 1950 to 1954, French speleologists gathered high in the Western Pyrenees, where Atlantic gales annually sweep the wild, eroded limestone terrain with nearly one hundred inches of rain. Bset by persistent fog, hail, icy winds, snow, and dangerous electrical storms, they discovered and later explored a vertical pit more than 1,000 feet deep. There in the Gouffre de Pierre Saint-Martin in 1952, Marcel Loubens fell to his death, and in 1953 his companions extended the descent to 2,389 feet, a record depth surpassed only in 1954 in a cave in the French Alps.

Casteret presents a lively resume of these expeditions and a vivid first-hand account of the one that brought Loubens' body to the surface, an incredibly difficult and dangerous exploit. Though he had a thousand caves to his credit in thirty years of exploration, Casteret had never seen anything to compare with the vast extent and complete chaos of this mighty underworld canyon. Every trip revealed fresh rock falls—this was the earth in labor!

From a practical viewpoint the work of these speleologists may have an important outcome. The underground river that they traced for two miles probably will be tapped to bring abundant hydroelectric power to remote valleys.

In the final third of this little book the world-famous cave explorer recalls some of his more interesting discoveries and experiences, especially his studies of bats. In a sense, this very readable book epitomizes the growth of speleology, from the day in 1922 when Casteret, naked and alone, swam underwater and discovered the world's oldest statues.

Today, in contrast, recent expeditions down Pierre Saint-Martin planning to spend weeks in perpetual night, were aided by French military planes that dropped tons of supplies and equipment at the cave's mouth. Teams of explorers were lowered a distance equal to the Eiffel Tower and the Notre Dame Cathedral combined, on a steel cable one-fifth of an inch thick.

For those who can't go exploring caves, this vicarious experience in the earth's unstable crust offers thrills enough.

CHARLES E. MOHR

THE WORLD OF NIGHT

--- by Lorus J. and Margery Milne

Harper & Brothers, \$3.75
248 pp., illus.

IF one considers that a year is divided equally between night and day it is apparent that man, by gearing his activities to the daylight hours, misses a great deal of what happens after dark. The authors of this book first describe the circumstances that distinguish night from day, explain the variation that accompanies change of latitude, and give interesting glimpses into the workings of our complex world, which is as dependent on darkness as man is on light.

The book deals with environmental backgrounds such as forests, waterways, jungles, deserts, and cities. Events that take place there while the world of man is asleep, are vividly described. The authors have a keen sense of the dramatic, and when they call an actor onstage it is seldom for a bit part.

The treatment of the subject is broad and although it leads to generalizations that may seem rather sweeping at times, they are, however, the result of both academic background and field experience.

The reader may be surprised to learn that man is as well equipped visually for activity at night as many of the creatures of night, although he does lack some of the highly specialized perceptions of touch, smell, or hearing. If one has patience and some knowledge of the out-of-doors, one can find a great deal of action between dusk and dawn and opportunities for direct observation.

The writers have roamed at night over selected areas in the United States, Canada, Central America, and Panama and have drawn heavily upon personal observation in establishing their theses.

This is a very entertaining, instructive, and thought-provoking book. The black and white illustrations are attractive and suggestive of the world of night.

HAROLD E. ANTHONY

THE REPTILE WORLD

----- by Clifford H. Pope

Alfred A. Knopf, \$7.50
325 pp., 221 photos

TOO often books on scientific subjects designed for the laymen are less than satisfactory; either the author himself is a layman and not qualified to evaluate his sources, or if a qualified scientist, he is not entirely at home when writing for non-scientists. In the present instance we have the happy combination of an excellent scientist who is capable of presenting accurate information in an appealing manner.

Clifford Pope's book is a general survey of living reptiles, with emphasis on natural history. An account of each of the main groups of reptiles covers such subjects as classification, age, growth, size, food habits, reproduction, defense

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against enemies, relations to man, and the explosion of popular myths concerning reptiles.

Specific information on reptile families follows. This section is packed with well-chosen information on genera and species culled from scientific literature and from the author's own extensive observations. In a small group, such as the crocodilians, the author is able to write about each of the species, while among the multitude of snakes and lizards, the treatment has necessarily been more selective, with emphasis placed on those found in North America.

Readers familiar with Pope's earlier books will expect, and find, occasional anecdotes such as a fascinating (and incomplete?) story of a captive snake that escaped and was later found hidden in a toilet bowl. Particularly useful features of *The Reptile World* are the bibliographies that follow each major section, and the excellent photographs. While the book will find its widest audience amongst amateur naturalists and budding

herpetologists, professional naturalists will also find it an invaluable source of accurate information.

RICHARD G. ZWEIFEL

STILL DIGGING

----- by Mortimer Wheeler

E. P. Dutton, \$4.00
236 pp., illus.

AT one time or another, Englishmen of note write their autobiographies — it is practically a national phenomenon. In keeping with this time-honored tradition Mortimer Wheeler has composed an account of his life in a style that combines Pops, Churchill, Roberts, and Babur the Tiger, to good effect.

Two subjects form the body of his book — war and archeology, but it is in the latter field that Wheeler makes his contribution, and his account of his work provides reason for reading the book. Wheeler ranks alongside the great English archeologists Arthur Evans, Leonard Woolley, and Flinders Petrie in his accomplishments and is a step ahead of Evans and Woolley in his organization of excavations and publications.

Without losing sight of his pioneer work in Great Britain, France, and India, his founding of the Institute of Archeology (now a part of the University of London) must be counted his most notable achievement. The Institute treats archeology as a separate discipline, using all fields of science as its tools. Students learn first-rate techniques and aim at finding the pertinent facts of the past. The best British archeologists of the day were students at Wheeler's Institute of Archeology — a tribute to its founder.

Wheeler's zeal for scientific method in archeology, however, has given him a certain intolerance toward methods other than his own, as American archeologists have discovered. As one who has attempted to use "New World" techniques in Wheeler's bailiwick, Pakistan, I can vouch for both this intolerance and his accomplishments.

All those who find archeology interesting or who like any story of the successful pioneer will find *Still Digging* eminently worth reading.

WALTER A. FAIRSERVIS, JR.

THE STORY OF OUR EARTH

----- by Richard Carrington

Harper and Brothers, \$3.00
240 pp., illus.

ASIDE from a little background information and some remarks on the history of science, this is a straightforward report of the known history of life, from the origin of the earth down to the appearance of human civilization. Encompassing all this in just 225, not particularly crowded, pages is something of a tour de force.

The story is clearly presented and the style is adult and interesting. The British

author, formerly a TV script writer and lately a popular writer — on scientific subjects mainly — has done a competent job of reading the more authoritative popular to semitechnical literature on his subject, and has produced an honest report embodying that information.

Although he does fall into some pitfalls of factual error or misplaced emphasis, few of these slips are of real importance. The book is adequately sound and can be recommended to the interested layman. Thirty half-tone illustrations and a number of line drawings usefully supplement the text, but to this reviewer some seem downright repulsive.

G. G. SIMPSON

PROSPERITY BEYOND TOMORROW

----- by Samuel H. Ordway, Jr.

Ronald Press, \$3.00, 208 pp.

TOMORROW'S BIRTHRIGHT

----- by Barrow Lyons

Funk & Wagnalls, \$5.00, 424 pp.

THESE two books have a common central theme — the misuse of our diminishing natural resources, — but the direction of the discussion and the conclusions reached are somewhat different.

Ordway directs attention to the heavy toll man is taking of our natural resources, both directly for his own use and indirectly, when his impact upon his environment brings about such things as erosion, and dust bowls. This is a calm, statistical presentation, logical and scholarly. The blame is not ascribed to any particular segment of the human race; attention is directed to the natural and understandable inclination of man everywhere to take everything the world has spread before him. The author's thesis is so well supported that the reader is left with little doubt that the continuation of the present trend can end only in disaster for mankind and the world at large.

As defined by Ordway, man's status is conditioned by an "overconsumption of resources and a basic lack of human sympathy with nature." He believes that the race between unrestricted human population growth, and the available food and economic resources for a satisfactory standard of living will always find man ahead. In other words, population is continuously renewable and many of the things man needs are not. The logical way to balance pressure against supply is birth control, which may only slowly become a popularly accepted practice.

The author of *Prosperity Beyond Tomorrow* also places hope in the greater amount of leisure that is coming with man's increased efficiency. This may give him time to think and plan more wisely for the future and to consider the "survival of resources as the key to continuing prosperity."

Lyons takes a political and economic approach to the subject and is openly

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partisan in expressing many of his opinions. As a former member of the Bureau of Reclamation, it is not surprising to find him critical of the Army Engineers, of the Republican Party, of big business and of the private utilities, and to encounter his use of the federal yardstick, without the financial breakdown on its cost to the taxpayer.

Lyons does not take the reader as far as Ordway does in his look into the future. He advocates the regimentation of our natural resources, but even if this were done, they still would not be inexhaustible. As a statistical analysis, the Lyons book does not measure up to the Ordway study, regardless of whether the reader agrees with the author or not.

One may well pause to reflect upon the birthright that the present generation is passing on to posterity. If one is of the older generation, it is a sad commentary, indeed, to reflect upon the rapidly accelerating use of our natural resources as a result of modern technological advances. Use of atomic power will almost certainly hasten the industrial exploitation of many raw materials. Not only must we

utilize natural resources in the best interest of the present generation, but we must see to it that something is left to posterity.

HAROLD E. ANTHONY

LAND, AIR & OCEAN

----- by R. P. Beckinsale

Gerald Duckworth, 25 s.
370 pp., 140 figs., 32 plates

THIS book is a revision of a work on physical geography first published in 1943. It includes a clear, comprehensive, generally accurate, and up-to-date account of the basic principles of this subject. Many recent advances in the study of climate, land forms, oceanography, and geological processes are well-summarized, together with bibliographic references for each. Although designed primarily as a college textbook, it is well-adapted to the needs of the general public; many appropriate drawings and photographs add to its usefulness.

NORMAN D. NEWELL

LAND OF THE LONG DAY

----- by Doug Wilkinson

Henry Holt, \$4.00, 261 pp.

THIS is undoubtedly the best work on the life of a small group of the Canadian Arctic Eskimo since Stefansson. It serves in many ways to supplement the writings of Stefansson, who pictured the life of these people early in the century when the white man's culture had affected their customs very little. The present volume provides a vivid picture of the Eskimo of 1953-54 through the eyes of a man who spent a year in Pond's Inlet in northern Baffin Land with an Eskimo family.

Wilkinson's first adjustment to Eskimo life meant a simple diet of boiled meat, raw or frozen seal, duck, Arctic hare—or caribou, muktuk (whale skin), rare luxuries—and the occasional treats of bannock and pilot biscuits. Tea was consumed in quantities as long as it lasted.

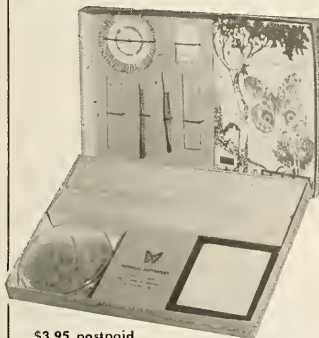
Throughout the short spring and summer, the hunters spent most of their time stalking seals sleeping on the ice beside their enlarged breathing holes. This involves hours of patient stalking on hands and knees behind a small white screen, through wet slush and shallow ponds of water.

Leads in the ice opened in July, and seals were shot as they swam in the open water. At this time of year, mature seals usually sink and must be harpooned immediately. In the autumn, seals float and the hunters work incessantly to accumulate stores of meat to last men and dogs through the winter trapping season. In October, when the sea began to freeze over, seals were hunted on the thin, rubbery, young ice, or as they broke through the surface to breathe and to keep open the holes they need for breathing during the coming winter.

During the year the hunters also gathered birds' eggs and killed an occasional

continued on page 333

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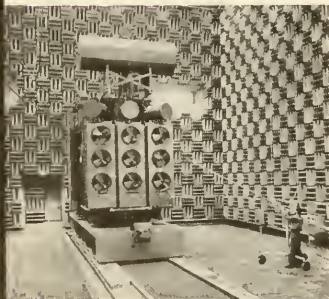
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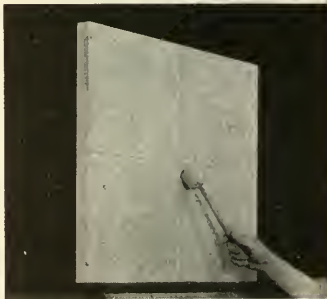
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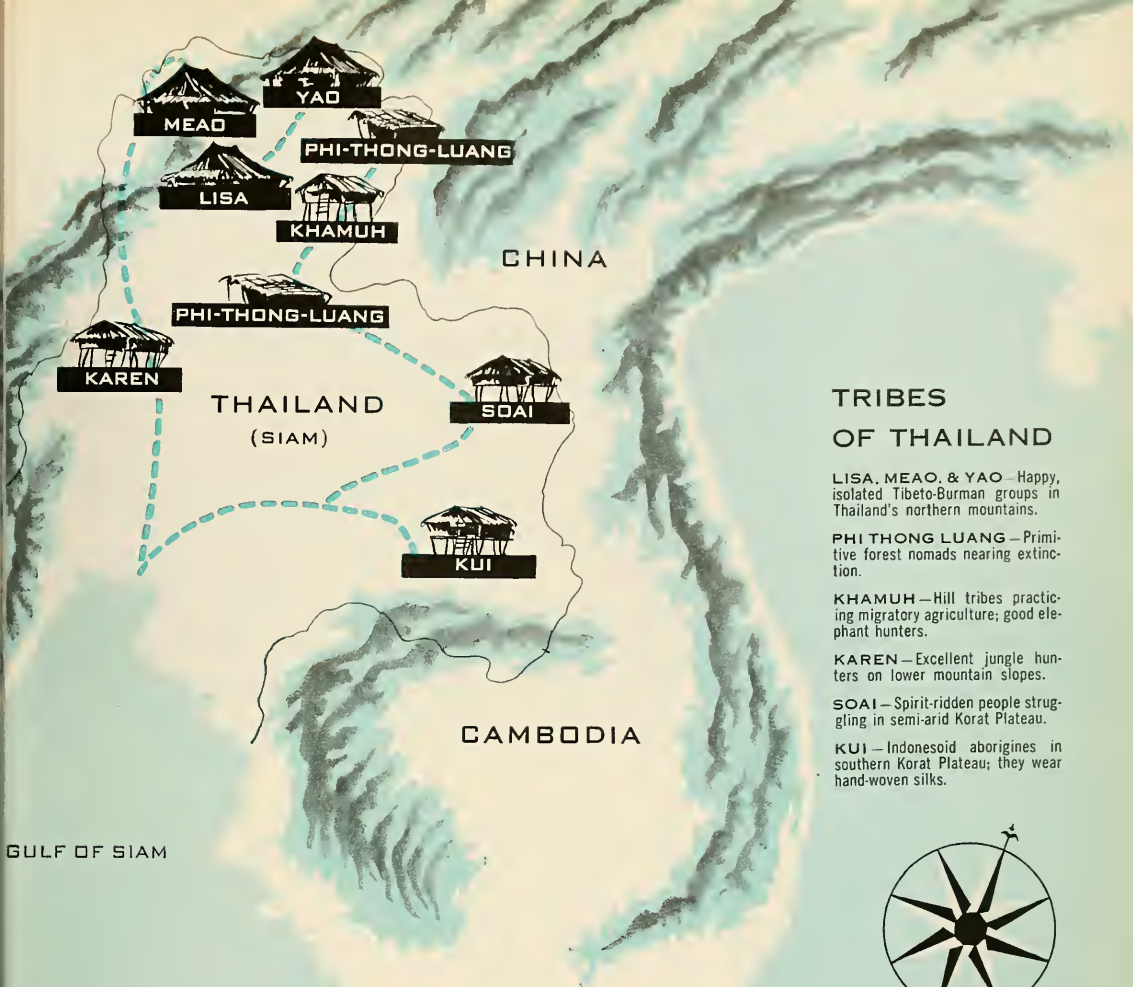


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TRIBES OF THAILAND

LISA, MEAO, & YAO—Happy, isolated Tibeto-Burman groups in Thailand's northern mountains.

PHI THONG LUANG—Primitive forest nomads nearing extinction.

KHAMUH—Hill tribes practicing migratory agriculture; good elephant hunters.

KAREN—Excellent jungle hunters on lower mountain slopes.

SOAI—Spirit-riden people struggling in semi-arid Korat Plateau.

KUI—Indonesoid aborigines in southern Korat Plateau; they wear hand-woven silks.



By
ROBERT W. WEAVER*

Through

UNKNOWN THAILAND

The story of a recent expedition which made contact with elusive forest nomads existing at one of the lowest stages of human culture

We recently had the strange experience of gathering information about a kind of "ghosts" that were supposed to haunt the mountains of Thailand and then, lo and behold, finding that they were real people.

We kept hearing about these

"Spirits of the Yellow Leaf" over quite an area. The better-educated people would smile patiently at the tales, as one might at the supersti-

tions of the illiterate or the imaginings of children. The "Spirits" were said to be part of the mythology of the region and as such might

*THE AUTHOR has long been interested in physical and cultural geography. For the past fifteen years, his attention has been centered on the wilderness areas of

India, Alaska, Burma, Labrador, and Thailand. When not exploring, he finds enjoyment in lecturing and writing on remote areas and their people.—En.



▼ THE AUTHOR in a dug-out on one of the jungle rivers of northern Thailand where many weeks were spent trying to find the elusive Phi Thong Luang.



Thomas L. Goodman

be interesting to students like ourselves, but nothing more. However, other informants grew quite earnest in their efforts to give us a clear idea of the actions and potentialities of these forest beings. But just when we were being swept along by the realism and consistency of the tales, we would have to remind ourselves that they portrayed a stage of life so primitive as to be unlikely in this day and age.

On generous grounds, we would have been justified in bracketing the Spirits of the Yellow Leaf with the Hairy Little Men who were believed to live in holes in the ground

◀ TRAVEL from civilized areas to the jungle was made by public bus. These up-country vehicles were usually loaded to capacity with rice, pigs, bicycles, and finally—people. It was not always easy for passengers to disentangle themselves during periodic stops.

▼ THE EXPEDITION often used native dug-out canoes in the long arduous search for the People of the Yellow Leaf. Laotian villagers are shown here loading the canoes for another stage of the search.

Robert W. Weaver



and to have no kneecaps—creatures who, if they fell while running, would have to drag their bodies to the nearest tree in order to pull themselves upright again. We might easily have dropped the search, but whenever our doubts were greatest, someone would assure us that the Spirits of the Yellow Leaf were real and that strange sounds heard at night in the jungle were caused by them. The Yellow Leaf people were also said to be responsible for the occasional disappearance of a hunter. The farther in we got, the stranger the stories became.

Some of our best information came when we inquired in villages about the Chaobon people, a minor group whose distribution we were trying to plot. In some places the Chaobon were unknown, and then the villagers might tell us about the Spirits of the Yellow Leaf, the Phi Thong Luang. Consistent accounts of the strange lean-to they built, led us to suspect that a firm foundation underlay these tales. It was their habit of abandoning their

shelters when the leaves of the roofs turned yellow that gave them their name. All agreed that the Spirits of the Yellow Leaf were able to fade away into the forest before the sharp eyes of the hunters, and their women were never seen.

So we resolved to find the Spirits or learn the reason why. On one of our trips to Bangkok, we learned that two occidentals had previously reported the existence of these people. The first, a Danish forester, told of accidentally finding a Phi Thong Luang campsite, complete with inhabitants. However, he failed to study the people systematically or to record any of the basic points of interest. His account was woven into a tale nearly as elaborate as those related by the villagers. A German anthropologist made the second contact and told briefly how he met the people and obtained a few photographs of them. The Danish forester immediately called these photographs "fakes" and accused the German of using Khamu natives to rep-



Thomas L. Goodman

▲ A TYPICAL VILLAGE of the Meao people, a Tibeto-Burman group, who were among the very few people the Phi Thong Luang would trust. This is in the high mountains region of northern Thailand.

resent the Phi Thong Luang. Both of these reports were published about twenty years ago and had not seemed to influence later stories of the illusive and little-known forest nomads.

We determined fairly early in our search that a group of the people had approached the village of Ban Sithan, at the foot of a large sandstone mountain called Pu Kathing in north-central Thailand. They had inquired about another similar mountain in the area, telling the villagers that the tigers of Pu Kathing had been killing their women and children and that they wanted to find another mountain like it but with fewer tigers. But about eighteen years had passed since this meeting, and the villagers did not know where the Phi Thong Luang had gone. It was assumed that they had moved to the north into a mountain range known as Pu Luang.

So our expedition moved to the Pu Kathing area—Thomas L. Goodman and I, with a Thai interpreter

and twelve native bearers. The search really began at this point. After studying conditions there, we followed what we hoped were the footsteps of the Yellow Leaf people into the more northern Pu Luang mountain range.

Through glare and gloom

We spent many hours questioning native hunters, village chiefs, and elderly villagers. Week after week, we walked through hot arid regions where scrubby bamboo thickets and stunted trees were the only growth. In other areas it was necessary to penetrate dense, humid evergreen jungles, where little sunlight splintered through the heavy green canopy. Elsewhere the trail led us across flat valleys between walls of elephant grass, where the dry air never stirred and vision was limited to the three-foot width of the trail.

Here and there we saw a hunter or two who had seen what was thought to be a Phi Thong Luang many years ago. Some, when hunt-

ing far from the normal trails, had found deserted campsites. Once in a while, a hunter would say that he had come upon a deserted campsite where the embers of the fire were still warm when he touched them.

We were feeling better and better about our chances of finding these people as we traveled north and west, for we got more recent reports. One hunter had seen two of the nomads only four years before. A little farther on, a village chief stated that he had sent his hunters into the jungle to try to capture a Phi Thong Luang to put on display in a village festival. He intended to charge admission. Each day, we felt that our travels might bring us to the end of our search.

The end of the search was near, but it wasn't to be so simple.

We had learned in the very small mountain villages that the Phi Thong Luang used spears nine to ten feet long, with a sharpened wooden tip in place of metal or stone, which they were unable to



Thomas L. Goodman

◀ A GROUP OF MEAO VILLAGERS who contributed information about the People of the Yellow Leaf.

fashion. They were also known to engage in "silent" barter, procuring much-valued fragments of machete blades in exchange for honey and wax. The Phi Thong Luang would leave their honey and wax along a trail leading into the village, and the villagers, upon finding it, would deposit broken machete blades, old clothing, or food. If the exchange was not satisfactory to the nomads, a pair of them might approach a lone hunter or go to the edge of a small village for more direct trade.

Armed with this knowledge, we sent several hunters into the forest, each laden with machetes, food, small knives, and cloth. The hunters were instructed to travel singly, not even in pairs, and to follow the small animal trails instead of the ones normally used.

Finally, our hopes were rewarded. One of our hunters was stopped by two Phi Thong Luang men, who eagerly indicated that they desired a machete!

The hunter showered the men with gifts and told them of the white friends who desired to meet them with many more presents. But the Phi Thong Luang would not accompany the hunter back to our camp. Before leaving them, however, he was careful to assure them that our assistance was ready should any of their clan be ill. This promise later proved to be the clincher that enabled us to meet them.

As soon as it could be arranged

after this exciting news, our expedition broke camp, and an advance party proceeded into the mountains to meet the nomads. After about a six-hour walk, which placed the party on the lower bamboo-clad slopes northwest of the village of Dan Sai, we met the two Phi Thong Luang who had received the gifts. We established an overnight camp at this point, which permitted us to start making friends with our long-sought people of the wild. The next morning, they led us to their campsite, which was only a short distance up the trail beside a small mountain stream in dense bamboo thickets.

All that the tigers left

The entire clan consisted of six men, one woman, and a boy. The tigers had eliminated the rest of the women and children, and endless wanderings had failed to bring the clan into contact with another group of their own people.

Our first strong impression was of a deep feeling of melancholy that seemed to pervade these people. Our gifts and food, though highly valued, were received with little display of emotion. During the ten days we were with the clan, not even the suspicion of a smile crossed their faces. They never once raised a voice in anger, fear, or joy. They seemed to talk among themselves only when the necessity arose.

Early the second day, we began

to record what we could of their way of life. Like small children, they followed in confidence our instructions. However, unlike small children and most primitive natives, they showed little curiosity in our photographic and recording equipment and no fear of it. Since their dialect was quite unknown, we wanted to make recordings of it. We could only make our desires known through pantomime and limited use of the Lao dialect. There was also difficulty in recording the very soft, high-pitched voices of the Phi Thong Luang men. The microphone had to be held only a few inches from their faces. However, we secured several hours of recordings.

We found that the clan normally arose at dawn, breakfasted on any food left over from the night before, and then either moved immediately into new territory, gathering food as they went, or scattered in the forest around their campsite. There they would seek wild yams, bamboo shoots, small mammals, and other food. With the exception of the time involved in moving their campsite, every moment of the day was devoted to gathering food. The woman and child in this group stayed close to the campsite during the day and kept the fire burning. In addition to wood, the woman gathered edible herbs and roots from the immediate area. The men usually hunted in pairs. Rabbits, porcupines, rodents, and other small mammals were often obtained. Once in a great while, the men might spear a barking deer or wild pig.

The meat would usually be roasted over the open fire or boiled in green sections of bamboo. Seldom was it more than half-cooked. Any meat left over in the evening would be placed on a small bamboo mat and hung over the hot coals. This



Thomas L. Goodman

➤ SIX MEN, one woman, and a young boy comprise the only known members of the tribe. Note how short they are in comparison with the leader of the expedition.



Thomas L. Goodman



Robert W. Wenzel

◀ JUNGLE HAMMOCKS of the type familiar to service men who did duty in the tropics were used by the expedition. Camp was frequently made just outside a native village.

Thomas L. Goodman



➤ RECORDING THEIR VOICES. The Phi Thong Luang spoke so softly that two microphones had to be used in recording their dialects. A Siamese interpreter occupies the position between the tribesmen and the leader of the expedition, at right.

was really to protect it from insects and small animals, but the meat got dried and smoked in the process. They rarely obtained food to last more than a day or two.

Normally they would bake the edible roots, herbs, and shoots in the hot coals of the fire. However, they occasionally boiled them in sections of green bamboo. Salt was the only seasoning they used, and they often went for long periods without it. It was one of the items they tried to obtain through trade with the villagers.

This clan had no knowledge of transplanting or raising vegetables or grain. They did not use traps, snares, or nets, though they had watched the villagers use them from a distance.

So far as we know, the Yellow Leaf people have no stories of their origin or of the deeds of their clan. They did not sit around the fire

at night to discuss the day's happenings or the plans for the morrow, though possibly they might have acted differently had we not been there. The elderly men exchanged no yarns. When we asked why they had none of these pursuits, they told us that it was necessary to sleep the entire night in order to be able to hunt food all the following day. Competitive sports seemed to be unknown; they never attempted to see who could throw a spear the farthest or who could climb or run up a mountain slope the fastest. They made no toys for the child. Their life was indeed one of basic existence.

Crime was practically unknown in the clan. Only one form of punishment was used, and that only for a crime of physical violence, as for example if a younger man should strike an elderly member of the clan in anger. The guilty

person would be well fettered with rattan or pliable vines. His hands would be tied behind his back and his ankles drawn up toward them. He would then be carried far from the campsite and left on the ground in the bamboo thickets. After three days, the people would return to see if the tigers had killed him. If not, he would be released to rejoin the clan, with all forgiven.

They sometimes made a shelter that was even simpler than their regular lean-to, by simply sticking the butt end of a fan palm frond into the ground at a slight angle. This provided protection enough for one of these small people to sleep under.

During the dry season, they move their camp every day or so, according to the food resources. Bamboo shoots are unavailable at this time of year, and wild yams and other edible roots form their mainstay.



Thomas L. Goodman

▲ A YOUNG UNMARRIED CLANSMAN. He may never find a wife.

▼ A SCENE photographed during the ceremony for the cleansing of the spears. The large sections of green bamboo served for the cooking of the sacrificial pig meat. The lean-to was constructed specially for this ceremony.

Thomas L. Goodman



Rather than seek their food more than half a day away from camp, they will move to a new site, for it seldom takes more than half an hour to re-establish themselves after locating a new campsite. If they see native hunters in the area, they immediately move, even though food is abundant.

As the rainy season approaches, they attempt to locate themselves in an isolated area where there will be enough food and where some feature like an overhanging cliff will protect them from the elements. They do not use caves, for they fear the larger animals that seek shelter in them. They stay in one spot until the rainy season is over.

Although the temperature often drops as low as 10 degrees above freezing at night during the cold season, the Phi Thong Luang normally wear no clothing, and they

never bathe. Such cast-off rags as they possess have been obtained from hunters and villagers. A Laotian villager had cut their hair not long before we met them, but they usually wear it hanging down to their shoulders. They didn't know whether the short hair was an asset or not. They agreed that their necks were much cooler during the hot season but found that the mosquitoes now bothered them more.

Touchy spirits

Everything, with the exception of their spears, was shared equally. Each spear was sacred to its owner. If anyone else should touch or handle a spear, its spirit would be quickly offended. This was serious, because the spirit could either guide or misguide the weapon in flight. An animal would then have to be sacrificed to pacify the spirit. And for purposes of general insur-

ance, such a sacrifice would be addressed to all the spear spirits, whether they had been offended or not.

They so rarely captured an animal larger than a small rodent or porcupine that such an occasion would call for the sacrifice of the animal, not only to the spear spirits but to the powerful ancestral spirits of the clan as well. These are good spirits, but they can cause the clan considerable difficulty and suffering. The spirits cannot locate food for themselves even though they roam the jungles as their living descendants do. And when the ancestors become hungry, they inflict illness upon the living people to let them know they need food. The clan must then sacrifice an animal.

Minor illnesses are not attributed to the spirits but to a variety of other causes. A slight case of indigestion or stomach pain, for in-

continued on page 336

▼ THE SACRIFICIAL PIG MEAT was placed on a small bamboo platform under the lean-to and left there overnight so that the spirits could feast upon it. The next morning, it was removed and shared by the clan.

Thomas L. Goodman



▲ A SECTION OF BAMBOO was used for carrying water from a distant stream or spring. The shoulder strap was improvised from strips of split bamboo.



▲ STEPHEN FLEAY, son of the well-known Australian naturalist David Fleay, exhibiting a couple of the giants: a ten-ounce earthworm measuring four feet three inches in one hand, and part of a larger one in the other.

Fishe

By MILDRED D. BELLOMY
Photographs by DAVID FLEAY

I recently went on a hunting expedition to capture four-foot earthworms with a friend of mine in Australia. He hunts them regularly as food for his platypus, which he has named "Gluttonous Teddy."

I soon learned that "listening to the earthworms play" is no meaningless phrase. During wet spells, or very early in the morning on a normal day, the worms are near the surface. They are quite sensitive to footstep vibrations, and wherever we walked across the muddy Queensland flats, we heard weird groaning gurgles as the giants retreated into their water-logged burrows.

To hear the worms, however, is one thing, whereas to capture one intact is quite another. My friend spaded into dozens of burrows before he found one with enough worm exposed. When he grasped the worm, it sprayed, from pores on its back, jets of milky fluid a foot or more in all directions. Normally, the worm secretes this coelomic fluid underground to lubricate its passageway. Recently, scientists have discovered that the fluid also serves as a defense against soil bacteria and small parasites.

As soon as my friend grabbed this worm, he quickly tied a knot in it. Otherwise the worm could vanish down its slippery burrow in the twinkling of an eye. My friend then dug the remainder out, carefully following the twisting burrow to avoid injuring his prize. A worm hunter can't grab the first piece of worm he sees and start pulling. The giant will distend its body in-

an's Delight



Once sought after by anglers as bait, the giant earthworms of Australia now enjoy semi-protection as scientific curiosities. Some reach a length of eleven feet and weigh a pound-and-a-half

side the curving burrow and hang onto the sides so tightly that the piece will come right off in the hunter's hand.

If you have patience, you can ease the giant worm out of its burrow, inch by inch, as it weakens and loses its grip. The bird known as the Laughing Jackass, or Kookaburra, uses this technique. The sharp-eyed bird spots a worm from an aerial lookout and pounces. Seizing a piece of the worm, the bird braces itself and sits back to wait. Each time the victim eases up, the captor gives a quick tug and takes up the slack. Finally the worm weakens, and the last inch slips from the burrow. But because these worms range from four to eleven feet in length and weigh up to a pound and a half, the bird is grounded for its meal, being quite unable to fly away with the whole worm.

The bulbous head-end is equipped with a transverse slit for a mouth, a quarter of an inch wide. With this the worm tunnels through the earth, swallowing soil and passing it through its body to extract nutriment. My friend says that the worm's "head" is much tougher and more muscular than other parts of the body and that unless it is sliced up, it is beyond the chewing powers of his platypus.

The giants were once believed to exist only in Australia's Bass Valley district in Southern Victoria, but recently they have been found in several parts of Queensland as well. When early settlers in Australia discovered the worms, they



▲ THE SLIGHTLY BULBOUS HEAD END of the Australian giant is so tough that the platypus will not eat it unless it is cut up. It serves as an anchor when the rest of the body contracts for a rapid retreat down the burrow.

thought they had unearthed a new kind of snake. But zoologists at the museum in Melbourne quickly identified the creatures as relatives of the common fishing worm.

The worms were formerly captured whole or in part by fishermen for use as bait. They have also been hunted assiduously by curiosity seekers. Today, however, they en-

joy a state of semiprotection and are taken mainly for scientific purposes or as food for captive animals who show a definite preference for an earthworm diet.

Two Sexes in One

So far as their reproduction is concerned, Australia's giants are no exception to the hermaphroditic rule among earthworms. Each individual is provided with both male and female organs. The eggs are laid in a capsule or cocoon produced by a special organ known as the clitellum, which secretes a sticky material. This clitellum is situated in an easily recognized band on the worm. The secretion is soft at first but hardens soon, forming a sort of ring that passes forward, clear over the head of the worm. As the cocoon passes over the female apertures, the eggs are discharged into it, and as it moves forward, they are fertilized by the products of previous copulation. The worm can never fertilize its own eggs.

The egg capsule of ordinary earthworms is usually a small, slightly lemon-shaped body. Three or four of the ova inside are fertilized, but in many cases only one will complete development. In the Australian giant, the egg capsule is a big shiny sausage-shaped object as seen in the accompanying photograph.

The giant earthworms are not good parents. They are careless about their eggs, often depositing them in the open soil or slightly below the surface among grass roots. Recently-hatched worms measure about six inches in length and are exceptionally fragile. Even though they have been secured intact and are not subjected to further handling, the young will break into two or three parts.

In recent years, the giant worms seem to have become much less abundant. This may be due to excessive use of superphosphate on pasturelands. But scientists are not sure just what is happening to the giants and cannot predict whether they will stage a comeback.



▲ THIS THREE-AND-A-HALF-FOOTER may almost triple its length if given a chance. These worms can spray a milky fluid a foot in all directions.



▲ A NORMAL GARDEN EARTHWORM held for comparison with a four-foot specimen of *Digaster Longmani*.

▼ AN EARTHWORM BURROW and, at left, its plugcast composed of alimentary-passed material.

▼ THE EGG CAPSULE or "cocoon" of a Queensland giant earthworm.





Hugh M. Halliday from National Audubon Society

The Birds of Anaho

By Nell Murbarger



◀ UNDER THE BLAZING SUN, the pelican parents frequently bring water in their feathers to cool their young.

*Hugh M. Halliday
from National Audubon Society*

Lowering waters add what may prove a fatal difficulty to a large colony of white pelicans who commute 60 miles to feed their young

IT was like a morning lifted out of Time's beginning, before the creation of life and sound. As far as I looked in any direction, no movement was visible; neither was there any chirping of birds or rustling of leaves, nor even the faintest stirring of air. Only the glassy blue of a desert lake, the calm of desert sky, and, separating water from sky, a ragged fringe of burned volcanic mountains.

This was Pyramid Lake, in western Nevada; and my target on this June day was Anaho Island, five miles out from its western shore, where I was to keep rendezvous with what is probably the largest

nesting colony of white pelicans in the United States.

Anaho Island was set aside in 1913 as a federal wildlife refuge, and my visit had been made possible through the courtesy of Chester R. Markley, Manager of the Stillwater National Wildlife Area. He had arranged for me to accompany a representative of the U. S. Fish and Wildlife Service on the next routine inspection of the nesting colony, on June 20.

I had been waiting at the lake only a few minutes when a jeep station wagon, drawing a boat trailer, drew up to the landing. I saw that my escort was to be LeRoy

Giles, a pleasant young man from the Fallon (Nevada) Office of the Fish and Wildlife Service. Sliding the boat into the water, LeRoy fastened an outboard motor in place, and we stowed our lunches, canteens, jackets, binoculars, three cameras, and other photographic equipment.

Before casting off, LeRoy asked if I was taking plenty of film. "The last photographer I took to the island," he added, "shot 24 rolls in one day!"

Looking at barren little Anaho from this distance, I couldn't imagine what could have inspired such prodigious picture-taking. The

▼ ANAHO ISLAND (middle distance) from the shore of Pyramid Lake. This stretch of water will protect the birds from predatory animals only for ten years at the present rate of use for irrigation.

Nell Marharzer





Nell Murbarger

▲ MONTH-OLD pelicans raise clouds of dust as they move over Anaho Island in huge bands. The chicks at right are probably only two to four days old.



300-acre island presented only the drab gray-green of volcanic rock and calcareous tufa, with the growing assurance of blistering heat. But as we drew closer, a series of terraced beach lines rising above the shore puzzled me, and I asked about them.

These terraces, my companion explained, dated from the close of the Ice Age. They resulted from the shrinking of Lake Lahontan, which preceded Pyramid Lake and covered many square miles of territory in northwestern Nevada, northeastern California, and southern Oregon.

I was soon to realize that nature's process was being hastened by man's use of the water at a rate that would probably doom the bird colony within ten years.

From the water's edge to Anaho's rocky crown, 557 feet above the present level of the lake, not one tree or one speck of green meadow was visible. Rounding the northern tip of the island to gain a safer landing on its protected east shore,

we came suddenly in view of a massed cloud of snowy birds—pelicans, whose black-edged wings spread nearly ten feet from tip to tip. LeRoy beached the boat while this vanguard circled nervously above; and we struck out afoot for the higher slopes of the island. We made our way through low, prickly thickets of greasewood and saltbrush. About 150 feet above the water's edge, we entered Anaho's main nesting colony of *Pelecanus erythrorhynchos*, the white pelican.

How many pelicans nest annually on Anaho is difficult to determine accurately. Observations have been made here since August, 1882, when 1400 young pelicans were counted. In May, 1951 (before hatching was

completed), David Marshall and my escort, LeRoy Giles, counted 5650 nests and 3742 young. But by 1954 the colony had decreased to about 3500 nesting birds, and it was LeRoy's opinion that not more than 3000 pelicans had nested on the island in 1955.

Increase or decrease, there were nests everywhere—although it must be admitted that the term "nest" could be used only as a figure of speech. LeRoy explained that at the start of the nesting season, the adult bird scratches together a pile of dust and gravel and shapes this with its body into some semblance of a nest, the completed structure being about three inches high and fifteen inches across, with a slight

concavity in the center. Here, the two to four white eggs are laid. As incubation proceeds, these platforms are worn away, and at the time of our visit, the few unhatched eggs remaining appeared to rest on the bare ground with neither a cushioning layer beneath nor shade above.

The colony included young pelicans of every age. Some chicks were still in the eggs or had emerged only minutes before our arrival. Naked, sightless, and completely inert, a day-old pelican is one of the homeliest creatures of the animal kingdom—an object that only its mother could love.

"It's quite a sight to see the mother pelican feed these helpless little mites," said LeRoy. "During the first couple of days, when they are too weak even to lift their heads

from the ground, the mother gets down in an awkward position and slides the lower mandible of her beak under the chick's beak. Then the predigested fish mixture she has regurgitated literally flows into the youngster's mouth without any effort on its part."

Built-in Cooling System

Even though it was only mid-morning, the desert island was being pounded by a brassy sun, and I marveled that these helpless, newly hatched birds could endure the blistering heat! Once the moisture of the egg had evaporated from their naked bodies, their waxy, orange-colored skin actually seemed to shrink like that of partially-roasted fowls, and they lay there panting feebly through open beaks. I have since learned that the pouch of the pelican, although primarily adapted for helping to scoop up fish, has recently been found to serve a purpose in heat regulation. When the birds pant in hot weather, the membranes on the inside of the pouch provide an additional surface for cooling by evaporation, as the dog's tongue does.

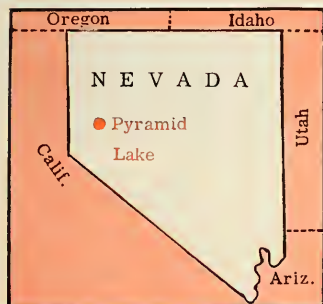
Whereas we usually think of a mother bird keeping her eggs warm, the pelican has to keep hers cool. She makes frequent trips to

the lake to wet her feathers; if she didn't, the heat might kill the embryo. If not frightened away, she stays close to the nest while the chicks are small, shielding them with her body and bringing water in her feathers.

The adult birds are extremely wary, however, and will not remain at their nests when anyone is in the immediate vicinity. This is one reason why the Fish and Wildlife Service does not permit uncontrolled visits to the island during the nesting season. An extended visit in the heat of day can cause many eggs or chicks to be destroyed by the heat. LeRoy and I were therefore careful not to remain in any one nesting locality more than a few minutes.

By the time the young pelican is three days old, he has doubled in size, is sprouting pinfeathers, and is becoming somewhat cocky. Before the end of his first week, he is covered with a thick coat of white down. He has now mastered a few of the fundamentals of walking and has developed an urge to see the world.

Waddling clumsily, with frequent tumbles and somersaults, he makes his way to the nest of a neighbor chick. Here he rests a bit. Then he and his new friend waddle and



Nell Murbarger

(Left and above) Double-crested cormorants, whose many nests are clustered a quarter mile from the pelicans.



▲ SOME 2000 California Gulls and their young form a raucous village at the south end of the island.

➤ THE CHICKS felt like a double handful of milkweed floss, but the adults kept diving and screaming.



somersault to the home of another neighbor. This recruiting drive continues until five or six of the young birds have formed a small pod, as young pelicans are collectively called. Before the chicks are two weeks old, several of these small groups will have joined to form a pod of twenty to thirty members; and at three or four weeks of age, they will be roaming the islands in pods of 1500 or more birds.

We had penetrated the island but a short distance when we sighted one of these juvenile mobs—"The Thundering Herd," LeRoy called them. Moving over the slope ahead in a light cloud of dust, this mass of grayish-white pelicans had much the appearance of a small band of sheep. Even though they still wore the thick white down of babyhood and were unable to fly, they covered the ground so rapidly that we foot travelers could not completely overtake them. Every renewed burst of speed added to their

already clownish appearance. They were nearly half-grown and were altogether too top-heavy for their leg development. They waddled clumsily, with frequent "headers," and on several occasions we saw young birds use both wings like crutches.

We Made Them "Sick"

Whenever we approached nests containing chicks from a few days to a week old, the young pelicans would open their beaks belligerently, puff their throat sacks, and voice sharp warning cries. If these danger signals failed to repel us, they would resort to their last defense—vomiting their partially-digested breakfast. The larger chicks expelled fish that were as much as seven inches long, and LeRoy said he had even seen a young pelican disgorge one fifteen inches long!

"Another time," he said, "we counted the fish expelled by a young pelican, and he brought up

232 carp averaging 2 inches in length!"

In view of this prodigious appetite, it is probably fortunate that the fishes favored by Anaho's pelicans are not those preferred for human consumption. Their main food is carp (*Cyprinus carpio*), Lahontan tui chub (*Siphateles bicolor obesus*), cui-ui sucker (*Chasmistes cujus*), Tahoe sucker (*Catostomus tahoensis*), and a few Sacramento perch (*Archoplites interruptus*).

Unlike his relative the brown pelican, the white pelican does not dive independently for his catch. Instead, several pelicans work together, alighting on the water near the shore and thrashing their wings so as to drive a school of small fish into the shallows. The team then scoops up the fish into their capacious yellow pouches.

Owing to insufficiency of fish at Pyramid Lake, Anaho's pelicans commute daily to the ponds of the Stillwater Wildlife Management

Area, 60 airline miles distant. Fish are plentiful at Stillwater. The birds fill their pouches there and fly back to the island well loaded to feed their young.

With the arrival of a parent from the fishing grounds, the greedy offspring sets up a wild clamor and begins pecking impatiently at the maternal or paternal pouch. This boisterous form of entreaty continues until the adult bird opens its beak and coughs up a serving of the fish that have been air-borne so many miles. In its eagerness to feast on this imported table d'hôte, the youngster often thrusts its entire head into the older bird's mouth. Then follows an exhausting session of wrestling, straining, whimmying, and wheezing. When the parent bird's patience wears thin, it will shake its head peevishly from side to side and even lift the young pelican clear off the ground and swing it through the air like a bell clapper!

This feeding process, said LeRoy, goes on for weeks and months. Even those big, half-grown lunkers in "The Thundering Herd" were being fed by regurgitation! "It's positively amazing, too, how every pelican mother knows her own child," he added. "If a young stranger comes rushing out of the pod to be fed, the old pelican will beat it off with her wings and beak. She then hunts around through the pod until she locates her own youngster—and he's the one who gets the fish!"

Not until he is nearly full grown does the young pelican take to the water—and even then the parent birds may have to drive him into the lake. Flying, too, must be learned the hard way. Every pelican aviation course is accompanied by many mishaps. If the young bird's energy gives out while it is still in the air, there may be a crash landing—and, not infrequently, a broken neck.

But if a young pelican is one of the fortunate 40 per cent who survive the sundry hazards that threaten his daily existence, the first chill days of autumn find him a handsome, full-fledged bird, ready

to take his place in the southward-migrating pelican army. A few of these pelican migrants drop out at the Salton Sea, in Southern California, but the majority continue on to the coastal lagoons of Mexico and Central America.

Other Bird Cities

In addition to the pelicans, Anaho supports smaller nesting colonies of Double-crested Cormorants, California Gulls, and Caspian Terns, and scattered nests of the Great Blue Heron.

The main cormorant nursery is situated about a quarter of a mile from the pelican colony. Even if building space were stringently rationed, the cormorants could not place their nests more closely together! We found more than 1000 nests set cheek-to-jowl on slabs of calcareous tufa a stone's toss from the water's edge. Each was a ragged stick pile, about eighteen inches high, containing a shallow depression lined with coarse feathers. The whole structure was cemented together with the birds' own excrement.

In these rough nests, fully exposed to the fierce rays of the sun, could be seen all the stages in the cycle of reproduction, from bluish-green eggs through barely hatched young resembling inanimate blobs of soft, black rubber, to full-fledged adults.

During the young cormorant's first days of life, when his future beak is still represented by a soft, black snout and he is otherwise clad only in a leathery black skin, his appearance is much like that of some prehistoric reptile. Within a week, however, he begins sprouting the thick, black down that he will retain until nearly full grown.

Continuing by boat to the gull colony on the island's south end, where some 2000 adult birds and their respective families reside, we found absolute bedlam. Even those members of the colony that were not diving and screaming in pursuit of a shore-line school of minnows were as garrulous as a mob of bickering fish wives.

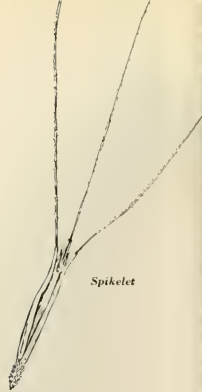
When we started up the beach, baby gulls began scattering before us like youngsters at a school picnic. Unlike the pelicans and cormorants, the California Gull is a well-adjusted individual almost from the moment of hatching. No sooner is the down on its back dry than it is out of its nest and scampering about on fleet and sturdy legs. Its baby coat—a thick, silky, sand-colored fleece, with dark brown dots sprinkled over the head—is retained for several weeks. Cuddling one of these down-covered chicks proved to be somewhat like grasping a double handful of milk-weed floss!

All the time that we were examining their colony, the gulls subjected us to continuous dive bombing—screaming, shrilling, and swooping down upon us and then zooming up just before striking our heads. But as soon as we headed out into the lake again, the colony began readjusting itself; and even before we had passed from their sight, the down-covered chicks were emerging from their fancied hiding behind drift logs, and their elders were resuming the eternal pursuit of food.

Anaho's bird colonies probably enjoy as good a life as is available to any of their kind, and they have returned and nested here over more summers than any man can say. But the future of the colonies is dubious, for Pyramid is unfortunately a dying lake. Although fed by the bounteous waters of the Truckee River, arising in Lake Tahoe, high in the Sierra Nevada, diversion of the water upstream for irrigation purposes is causing the lake's level to drop at the rate of 3.5 feet each year. In its deeper areas the water still is some 330 feet deep; but at its shallowest point, between Anaho and the eastern shore, the depth is only 33 feet. At the present rate of falling, another ten years will see the island connected with the mainland. And then, unless some satisfactory barrier can be devised, Anaho will become accessible to wild predators, and its bird colonies will be doomed.



Needle-grass
Inflorescence



Spikelet

THE *Needle-Grass*

BLIZZARD

Man and animal ran for shelter in a merciless storm of barbs
that piled up six-foot drifts in a New Mexico town

By HARVEY H. NININGER

In the summer of 1944, I witnessed one of the most amazing natural spectacles of my life. Coming to my office that morning in Artesia, New Mexico, I was forced to wade through shoulder-high drifts of restless, feather-light, needle-sharp darts. They penetrated one's clothing and into the skin as though they were hungry mosquitoes.

There was a high wind, and the streets looked as though they were being swept by a blizzard of straw-colored snow. When doors were opened, the barbed and plumed darts cascaded down the aisles, scattering over counters and onto shelves like swarms of angry wasps.

Most of the stores were closed against the attack. In others, the people were helping each other disengage the tormenting barbs. The stairs leading to my office were buried under the stuff. Attempts to sweep it out were as fruitless as trying to recover the contents of a bag of goose feathers in a whirlwind.

Closing the office for the day, I walked down the street. Almost everyone I saw had retreated to some semblance of a shelter and were engaged in de-needling their clothing and hair. A dog, whose tail had grown gray and four times its normal size, cowered in a doorway and was waging a losing battle against the tormentors lodged in

the more vulnerable areas of his skin. A more wily alley cat dashed to a high perch and settled down to a day of licking and preening.

What was this bristling horde? In the arid Southwest, the plant is locally known as "needle-grass" or "burro-grass." It is a short, fine-leaved grass, and it develops a silky pink-tufted fruit that can give a lovely tint to the landscape before it ripens. Normally, it is so sparse that it is not noticed except by sheepmen, to whom it is a constant threat. The barbed seeds bore through the growing fleece of the sheep and mercilessly puncture the skin and flesh, often resulting in infection and sometimes proving fatal. Its scientific name is *Scleropogon brevifolius*.

The barbed seed of this grass is so light that it is wafted along like a feather, until it sticks into the hard soil, gradually burrowing deeper and deeper. I counted the seeds in small areas at the time of the storm and found that they were planting themselves at the rate of hundreds of millions per square mile.

From the accompanying drawings you will see that each seed is armed on its lower end with a hard, sharp, spearlike point. Back of this point is a heavily-bearded section, and the opposite end bears three

long, slender, twisted bristles. Several seeds usually cling together, with some of the bristles projecting backward like tail feathers, others sprangling out Dutch-wind-mill fashion. These clusters roll along like tumbleweed, and if the wind is moderately high, they go tumbling through fields and pastures, doing cartwheels and end-over-end rolls. In town, the tufted seeds scurry along the sidewalks like the beginning of a snowstorm.

The seed, being heavier than the long slender arms, tends to strike the soil rather more than its share of the time. And as it does so, the slender plumes, which are microscopically bearded, tend to cling to objects they touch. During a pause in its flight, the spikelike seed can be seen to jab the earth like a woodpecker hammering a tree.

It was positively uncanny to watch those tumbling, spider-like seeds pushing into the network of tiny cracks in the very hard soil. After a sufficient number of fruitless jabs, the nose of the seed would find a crack and hang there just as though held by a magnet. As the wind worried them, they went deeper and deeper. I thought the backward-pointing barbs were solely responsible for this, but botanists seem to think the seeds are aided



▲ A NINE-YEAR-OLD BOY in the entrance to the patio of his home standing among heaped-up billows of the grass.

by changes in the relative humidity. Finally, nothing was visible except the long twisted bristles, and these might finally be whipped off by the wind.

Black-top roadways, where traffic had not eliminated the grass, supported a veritable lawn of straw-colored bristles. And the ranch road I commonly took through a pasture was hairy with them. Telephone poles and fence posts were literally haired over on their windward sides with the protruding bristles of seeds that had found cracks in which to burrow. Jack rabbits took on the appearance of porcupines.

Fortunately this grass is relatively rare except at infrequent intervals. Old-timers said they had never seen quite such an overwhelming invasion as the one I have described.



▲ A TELEGRAPH POLE bristling with the grass on its windward side. The backward-pointing barbs cause them to work deeper under wind action.



◀ THE ELABORATE BEAD COLLARS worn by the men are collector's item and bring high prices in Panama. This man was the champion in the contests held in Chiriquí where these photographs were taken. A different locality is used each year.



You BET Your Wife

The conventional way of breaking a marital triangle among the Guaymís of Panama is to hold a leg-breaking contest with eight-foot poles

▲ THE WIVES are usually confined in special shelters to keep them from getting intoxicated with the men. But when the contests begin, they are naturally among the most interested spectators.

By PEGGY POOR

Photographs by KURT SEVERIN



◀ THE DEFENDENT cannot turn around as the stick hurtles toward the calves of his legs. He gets his eyes from the sound of the stick and the reactions of the on-lookers, which include the wife he is trying to win from his opponent.

While sports fans in the United States are winding up the World Series and kicking off the football season, their Panamanian counterparts are hiking two, five, or seven miles through jungle and over mountain to attend the *balsería*. This favorite sport of the isthmus Indians is a rowdy rough-house. Its object is to break your opponent's leg and win his wives.

These contests are said to date from before the Spanish Conquest, and from all information available in the area, few non-aborigines have witnessed them. The modern-day natives, like their ancient ancestors have been chary of issuing "tickets" to outsiders.

By a happy coincidence, the schooner *Windjammer* dropped anchor in the East Panamanian port of Almirante just in time for her navigator and me to get included in an invitation that had been extended the Episcopal rector of the

THE AUTHOR, a former newspaper correspondent, has traveled around the globe in search of adventure and the unusual, once as captain of a small sailing vessel which was wrecked off Easter Island in the South Pacific.



archdeaconry comprising Bocas del Toro Province, home of the balsa-throwing Guaymí Indians.

The Rector, the Reverend Edwin C. Webster of Ripon, Wisconsin, shepherded our party of 7 persons nearly 50 miles by launch, canoe, horseback, and shank's mare to the interior "village" of Gobrante, on the shore of the swift running Cricamola River. It was an expedition for hardy souls. In fact, the fourteen-hour trek in itself could keep the balsaria from becoming a tourist attraction.

The "stick games," as the rare English-speaking Indians call them, are scheduled by the tribal chieftains, and they serve some of the



▲ A FANCY STRAW "BOATER" is an important part of the men's costume. The feathers have come loose on this one and are being fixed.



▲ A COWHORN TRUMPET announces the beginning of a bout. As many as 30 sticks will be hurled by each contestant. The man who is dodging the stick always keeps his back turned.

purposes of a domestic relations court.

The Guaymí take more than one wife, and since the women do a heavy share of the work, the married Guaymí leads a life of ease and luxury. A man's economic standing in the community, indeed, is judged partly by the number of wives he has. There are many bachelors, and they must shift for themselves. As a result, the wise husband at no time relaxes his vigilance over his women. The wily bachelors, and even other husbands poor in wives, have home-wrecking as a primary profession. The main season of danger comes when these games give ambitious males a chance to judge which women would make the best marital investments—that is, which ones have worked the best and been the best providers.

Then when hubbly is out hunting or drinking with the boys, the wife-stealer slips around to the back door with sweet talk and slick promises. Guaymí women are not indifferent to blandishments, and the affronted husband then demands a *balsería*. His chieftain sets the date to coincide with all of the tribe's similar grievances for that year. We were given to understand that autumn was the usual season for the contests, but it has been stated elsewhere that they occur at planting time. Perhaps the time varies.

To serve as a calendar, a cord such as is used in making fish nets is knotted with slip knots and strung from tree to tree across a jungle "crossroads." Each day one knot is pulled, and the remaining knots mark the number of days remaining until the date of the game.

Special delegations with conch shells and other noise-makers are sent to announce the event among more distant defendants or plaintiffs. Trails are marked with piles of sticks arranged in traditional patterns to point the way to the sports arena.

The Weapons

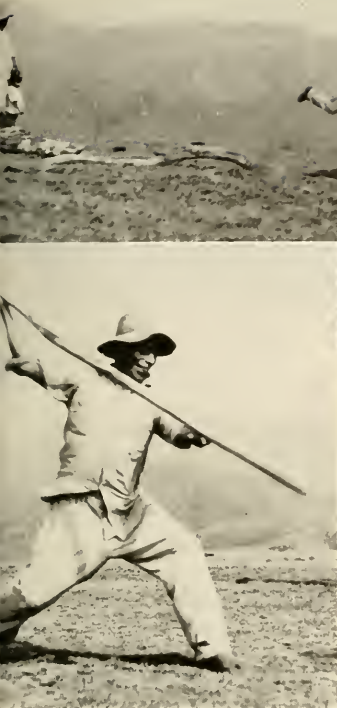
The "home team" gathers and cuts the poles of balsa wood. These are about 8 feet in length and 3 inches in diameter. They are smoothly rounded and slightly sharpened at one end. Though light in weight, they are more firm than human skin and can cause considerable damage. The weapons are stacked for drying on a tablelike stand about breast-high that has been built in mid-field.

The women meanwhile set to work preparing the food and an alcoholic drink made of sugar cane juice mixed with various herbs and combined with the fermentation of *piva*, a nutty fruit growing like dates on a species of palm. The taste is indescribable and the potency unpredictable.

The men exhibit much ingenuity in producing a wide variety of headgear. The favorite, however, is a sort of straw boater, banded with brilliant-colored ribbons and streamers and crowned with a thick shrub of dyed feathers shooting straight upward from the inner brim. Their garments are assorted, some of them from our world, including dungarees and tee-shirts, but showing a marked predilection for gaudy hues. The homemade trousers may be scarlet or magenta, the blouses chrome yellow or heliotrope. Many men wear flowered Mother Hubbards over their outer clothes. Others put on wide collars of bright-colored beads strung in geometric patterns. Most of them paint their faces in horizontal bands across the nose and cheeks, using ancestral dyes and modern lipstick. A few even sport a whole stuffed tiger or puma on their backs.

The women also paint their faces and wear Mother Hubbards reaching to about mid-calf, and they tie their hair with gay ribbons.

Often the jungle begins to ring a week ahead of time. The sounds are from conch shells, cow horns, turtle and skin drums, bone whistles, and metal police whistles imported from the United States. These latter come on small trading steamers from the Canal Zone and thence by canoe to the interior. Many of the contestants live as



◀ SOME FANCY STEPS precede the throw. The attacker then runs a short distance and hurls the stick with all his might.

▲ THE TRICK is to jump at the right moment. There seemed to be no rule as to how far apart the men should stand.

▼ UNLESS THE DEFENDER is injured badly, he will return the attack.



much as seven days away, and it is a rule to herald your approach as loudly as possible.

We arrived about dusk, and the preliminary festivities had got under way. Most of the visiting contestants had reached the fields hours earlier and had set up bamboo corrals roofed with banana leaves for their women. Some of these were simple lean-tos, others more like cribs or half-cages. Our host, Carlos Langer, half-Indian and half-German, explained that those enclosures were to keep the women from going out and getting intoxicated with the men.

The opponents-to-be of the next day's game were testing each other's strength. This was done hand-to-hand, the sticks being reserved exclusively for the morrow. The contestants squared off at each other, posturing like the battlers in an old Japanese print. The fighting was to a certain degree formalized, but it lacked the skill and preci-

sion of our boxing. The striking was not done with the knuckles but with the heel of the clenched palm. Grappling as in schoolboy wrestling was allowed, and so was grasping one's opponent's hair with one hand the better to pummel him with the other. But there was no hitting when a man was down. We saw no foul play.

Oddly, considering that the stakes were wives and wealth, all seemed to be in good fun. The Indians made a great show of ferocity, grunting and growling as they tussled, but after being separated, they

would hug each other affectionately and go off for a brotherly drink together.

The women watched from the sidelines in their cribs and shelters, smoking their pipes, comparing impressions, and discussing the "line-up."

Some of the Guaymí women are very pretty, if you look no further than their faces. Their figures, by our standards, are appalling, shapeless from the rear and all belly from the front. But the women doubtless have strength and sturdiness, qualities that must be admired



▲ FIRST AID in the open air "repair shop." Wounds are canterized with a red-hot nail. While the medicine man repairs this injured ankle, the musicians pipe away in holiday spirit.



▲ THOSE who become too obstreperous and want to continue the fight with machetes beyond the playing field are put in the stocks, which replace the jail in this part of the world. They will remain here until they are sober.

by their squat, flat-faced husbands.

We had been told that our presence might be resented, but none of us found evidence of this. We wandered in and out and gossiped much as we would at a country fair at home. It was difficult to communicate with most of the Indians, as few spoke even Spanish. Those who did, chatted amiably with us; the others responded to sign language.

Scientific studies have stated that neither romance nor lust enters into the balseria tradition, that it is purely a matter of economics. But we observed several couples, arms about each other, wandering off into the surrounding darkness.

The fighting, drinking, and visiting went on all evening. Then, about midnight, some signal difficult for an outsider to distinguish amidst the general uproar, caused the husbands to gather in a circle, facing inward. Each was held about the waist by his wife or wives, and the men prance-danced in a somewhat stylized manner, chanting a deep atonal guttural so untamed as to "curdle our blood."

The single men then used elbows and knees to try to pry the women loose. Here the female had some freedom of choice. A woman who wanted to stay with her husband would hang on for dear life, while others would be pried away with suspicious ease.

At another signal, the prancing and chanting ceased, and the lineup was arranged. The two chief contestants then agreed as to the number of balsa sticks each would lance against the other on the following day to settle their quarrel. The ones we were watching agreed upon 30 each.

The clamor resumed louder than ever, and presumably the roistering went on all night. We stumbled wearily back to the general store, where we had been given a room, a small cubicle containing only an iron double bed. This by common consent went to Dr. and Mrs. Ludwig Jaffé, who were the weariest. Besides, Dr. Jaffé had sprained his ankle in a mud bog. Rosalie Bayne,



▲ AFTER THE FESTIVITIES, the visitors file home to their villages. Some of the participants are crippled or injured; some have changed their marriage partners; all have experienced a stirring social rite.

Jim Cox, and I, on the other hand, felt claustrophobic about the room and rolled up in our blankets on the porch between some Indian wives and babies. We might as well have curled up by the Information Booth in Grand Central Station. The traffic was heavy all night, and the Indians by no means light-footed. Fortunately, none of us got actually stepped on, but it was not a night for sleeping.

The Clubs Fly

Just at dawn, the two chieftains squared off on the field, which was a large flat grassy area of about two acres. One selected a balsa log from the center pile and cavorted around the field, testing the weight and balance of the stick while growling deep in his throat. The other assumed a stance with his back toward his opponent, crouching slightly, with feet apart and hands on knees. Thus he sidled and jumped, snarling as ferociously as the other. The attacker made ready, resting the pointed end of his stick against his right palm and balancing it with the left hand about center. He then hurled the balsa full force against the calves of the other man's legs. The defender tried to avoid it by dancing and hopping.

The first stick hurtled harmlessly between the defender's outspread legs. Now it was his turn, and the positions were reversed. There

seemed no rule as to the distance from which the attacker might throw. The next lance scored a terrific wallop on the ankles. The successful player, waving his arms above his head, ran caterwauling his triumph among the encircling spectators.

Having proclaimed his skill, he returned to be attacked again. So the play went on until each man had launched 30 balsas against his opponent. After that, though we thought one of the men had won, the two bitter rivals ambled off with arms about each other for a friendly drink.

Now anyone could play, and what seemed to be a grand free-for-all resulted. We were told, however, that the procedure was systematic and that selected individual contests were adhered to.

The game is brutal—"murderacious," as Willie Waite, the part-Indian storekeeper, declared. But fortunately, the hilarity and dissipation of the long night's vigil cut tellingly into the skill and precision of the balsa throwers. All were groggy, and they began again at dawn administering the "hair of the dog" until soon everyone was once again inebriated.

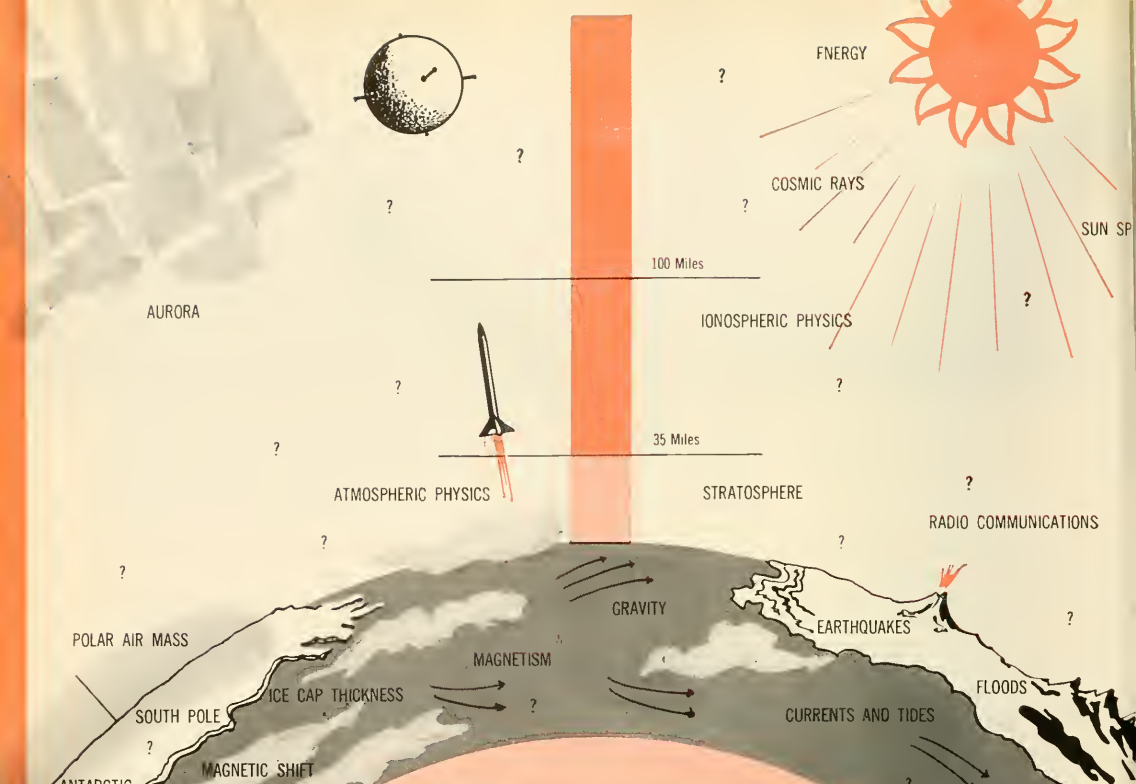
Serious injuries do frequently result, we were told. These are treated by the insertion of an ordinary nail, heated red-hot in a fire of balsa wood.

Regrettably, our party had to

start back about mid-morning in order to get Father Webster home for Sunday services. We were assured that the program would continue through the daylight hours or until the last balsa log was broken against a contestant's calves. It would then be the duty of the losers to gather up all the broken sticks and heap them in the center of the field for a huge bonfire. Around this, the men would assemble for ritualistic dancing and monotonous chanting in which the singers would brag of their prowess in this and former balserías and in balserías to come. The women would heap the banana-leaf plates with bright orange-colored concoctions of corn and coconut, rice and squash. And the dried gourds that serve the Guaymís as wassail bowls would circulate until all the weary jousters had passed out or were too sleepy to go on.

The next morning, or when they had regained sufficient strength, the new matrimonial alignment would be settled until the next balsería. Visitors and home team would then return to their huts and normal routine.

We seven privileged outsiders, having shot the Cricamola Rapids and scrambled over the steep, slippery hills that rise from the Laguna de Chiriquí, slumped gratefully into the Episcopal dugout launch, *Espiritu Santo* (*Holy Ghost*), and chugged wearily home to Almirante.



What I.G.Y. Will Do

The launching of the first earth satellites and the prying open of the Antarctic continent are only two of the daring projects that will mark man's greatest concerted attack on the unknown

By WILLIAM BARRY FURLONG

"NATURE never refuses to answer our questions—but the quality of the answer depends upon the quality of the question," says Dr. Serge Korff of New York University. "To get thoughtful answers, we must ask thoughtful questions."

Next year, in July, 1957, history's most intensive cross-examination of nature will get under way. This thoughtful, well-planned

grilling will last eighteen months and enlist thousands of scientists in almost three-score nations. The answers may well constitute the most significant and profound discoveries in the physical sciences in the next half century.

The project: the International Geophysical Year, or IGY as it is called. The examiners: at least 5000 of the world's most

distinguished scientists. The field of examination: our environment.

The international impact of the Geophysical Year has already been demonstrated. It was the harbinger of the brief spring in the chill winter of relations between the East and West. Long before the Soviet Union or China made any comparable diplomatic overtures, they came forward to join the other nations of the world in IGY.

IGY is the wedge that is prying open a new continent; Antarctica will bristle with a dozen bases operated by different nations during this super-year of science. IGY is also the catapult toward new frontiers in space. The U. S. and the Soviet Union have already announced that they plan to launch the first earth satellites during IGY.

Yet the meaning of IGY, and with it geophysics, has largely eluded the public.

Fourteen Sciences

What is geophysics? Quite literally—"earth science," the scientific study of our planet among the stars. Actually, geophysics embraces a number of sciences, most of them intimately familiar to the average person—meteorology (the study of the weather), oceanology (the study of the seas), seismology (the study of earthquakes and the interior of the earth), and a number of others. During IGY, some fourteen sciences will be used as tools to explore our environment. They all focus on the world about us—on the surface of the earth, on the atmosphere enveloping the earth, and on the restless forces within it.

Their importance? "Our environment affects our lives in a variety of ways," says Dr. Joseph Kaplan, chief of the U. S. committee on IGY, "from the clothes that we wear to the safety of air travel." The airways that carry our radio and television signals, the weather that guides our lives, the level of the water in our wells or reservoirs—all these are a part of the gigantic science of geophysics.

Great industries are built on geophysics. The petroleum industry

uses seismology to find new oil fields. The shipping industry uses—or fights—the tides in every port. The airline industry uses—or fights—the weather. Construction engineers in New South Wales, Australia, are now using cosmic rays to determine the density and thickness of the ground above them as they burrow through tunnels.

The military uses of geophysics date back as far as the legend—perhaps apocryphal—that the Greek scientist Archimedes (287-212 B.C.) used solar radiation to burn parts of the Roman fleet during one of the sieges of Syracuse. Weather helped drive Napoleon from Moscow and more than a century later sent Hitler's armies shrinking from the gates of the Russian capital. Floods, a classic tool of warfare, were used with surprising frequency as late as World War II. Through terrestrial magnetism, American geophysicists were able to devise a method of neutralizing the Nazi's magnetic mines by looping "degaussing coils"—heavy conductors carrying currents—around the hulls of ships.

Yet much of our environment is still shrouded in mystery. Physically, man's vertical range on this planet is only 21 miles—from the 4-mile probings of the deepest oil well to the 17-mile flight of a rocket-propelled aircraft. Scientifically, his range extends for hundreds of millions of miles. But man still faces with quiet determination the questions of eloquent simplicity: "What's at the center of the earth?" "What makes the earth wobble?" "Is our climate slowly getting warmer?"

Many puzzling geophysical questions have intimate implications:

Why do the boundaries of well-surveyed lots seem to shift with the passing of years?

Why do seldom-visited islands seem to wander or appear as much as a mile off their mapped positions?

What makes the Gulf Stream shift?

Why is the force of gravitation greater in some places than in

others? Another question arises.

What do all these mysteries mean? If you had a lot surveyed in eastern New York with respect to magnetic north a century ago, it would have rotated almost six degrees by now. If you've wandered among the Gilbert or Marshall islands in the Pacific—or any islands anywhere that you *had* to reach—you may have been dismayed to discover that they weren't just where your maps said they'd be. If you're of a betting nature, you might grab some odds that the 1956 Olympics will see new records—or at least better performance—in such events as the javelin, simply because the force of gravity at Melbourne, Australia, is less than that at Helsinki, Finland, where the Olympics were held in 1952.

The unexplained mysteries of our environment are the seeds of superstition. To the Eskimos, the northern lights are fearsome spirits playing a game like soccer with a walrus skull; in Estonian folk tales, they are weddings in the sky with sleighs and bangles and dancing lights. Only 200 years ago, an earthquake near Cambridge, Massachusetts, was blamed by local pastors on sinful parishioners. In 1811, another earthquake near New Madrid, Missouri, which was felt over two-thirds of the United States, was blamed on Mississippi river gamblers.

The Growing Fringe of Knowledge

As understanding grows, superstition dwindles. But understanding grows slowly. Benjamin Franklin labors with a kite and a key to discover electricity—a geophysical experiment. Henry Hudson clambers ashore at Hudson Bay and slashes a mark in a rock at sea level; three centuries later the mark is 60 feet above sea level—a geophysical bench mark. A pilot edges his plane into a hurricane to seek the hurricane's eye—a geophysical investigation that recently cost seven lives.

All over the world, wherever science flowers, men are trying to



Official U. S. Navy photograph

▲ ANTARCTIC BASES for IGY are already being set up. Photo shows USS *Glacier* and Task Force 43.

roll back the shrouds of mystery that engulf our environment. Their investigations are as varied and daring as the human imagination. Some men are trying to find out what's at the center of the earth. Through sound waves, they hope to determine the exact composition of the earth beneath its 30-mile surface crust—how much of the interior is molten and how much is solid rock.

Some men are trying to find out how much the earth is warming up, how fast its glaciers are melting, and what will happen as a result. Will all the icebergs and glaciers and the sheath of ice cloaking Antarctica melt? If so, how much will the level of the oceans rise? Will our coastal cities be flooded? Will new ports, now ice-bound, be opened for commerce?

Some men are trying to find out why the earth wobbles, why it shivers like a pup out of a pond, why it runs fast and slow. (It's been running fast since 1910.) Some of the reasons for its whimsies are known or suspected: it runs slow in May, by about .06 second, because of changes in wind current and ocean movements. It takes two seconds longer to make a complete revolution than it did at the time of Christ because of greater tidal friction. And its north and south magnetic poles wander about un-

certainly, causing changes in the boundaries of property and errors in navigation.

Some men are trying to find out whether the continents move and why. One theory: that the continents are "great rafts of plains and mountains" set upon dense but plastic bases that shift, almost imperceptibly, under their great load. One aim of IGY: to make a detailed study of latitude and longitude in order to check the movement of continents and to pinpoint any spot on earth to within 90 feet. The present margin of error: 200 to 300 feet or more.

Some men are trying to convert the energy from the sun into large electric power stations or into small units that could provide refrigeration in tropical countries, as well as pumps for irrigation and other uses. At least 25 countries are now experimenting with this idea. In India, a small solar cooker can be purchased for about \$16. In Algeria, the world's largest solar oven—one that converted the center of a magnesium firebrick into molten lava within seconds—is nearing completion.

All of these investigations, all geophysical experiments, have one problem in common: they recognize no national boundaries. The winds blow and the oceans flow without regard to what nations they

touch. The sun shines impartially on all. The Yangtze River floods China as implacably under the Communist regime as it did under the Nationalists and for reasons arising beyond China's boundaries. Magnetic storms sweep around the earth within a minute, sending navigational instruments into small but crazy gyrations, without inquiring as to the beliefs of the people below.

Simultaneous Observations

It has long been a problem to get enough data on an experiment when some vital phase of it is taking place somewhere else. The mail, telegraph, and radio have helped to ease the problem—but only slightly. What is needed is the simultaneous observation of geophysical phenomena all over the world, as well as the uninhibited exchange of this information.

This is the great vision behind IGY. On a spectacular scale, observations in the fourteen different fields of science will be coordinated and the information exchanged. The effort comes at a peculiarly advantageous time: solar activity during IGY will be reaching its eleven-year maximum.

This is not the first attempt to organize the world's geophysical efforts. The first attempt was made almost 75 years ago when the first

International Polar Year explored the influence of the arctic on the weather and investigated the aurora borealis and geomagnetism. The second attempt was made 25 years ago, in 1932-33, with the second International Polar Year. This effort included investigation of the ionosphere, an electric blanket that shrouds the globe, and its effect on telecommunications. "Without that knowledge, much of which we gathered in 1932-33, our telecommunications would be in a hopeless snarl," says Dr. Serge Korff. "The work that took place then opened a whole new era in telecommunications, whose value has been 20 times its cost."

At first it was felt that these well-organized grillings of nature should take place every half century. But as the twentieth century turned into its sixth decade, the world of science was wallowing in a new and luxurious era. Money was relatively plentiful; the depression had hampered the 1932-33 Polar Year. Besides, the new equipment now available for scientific research opened up dazzling possibilities. The tools for analyzing complex data, such as electronic computers, had suddenly provided us with amiable slaves that could do a decade's work in a few seconds. The opportunity was too glittering to ignore.

One evening in the spring of 1950, Dr. Lloyd V. Berkner, then working in the laboratories of the Carnegie Institution of Washington, was discussing these things with some colleagues at the home of Professor J. H. Van Allen of Iowa University. Dr. Berkner suggested that the timetable for the next coordinated effort in geophysics be moved up 25 years. This would put the next Polar Year in 1957-58 instead of 1982-83. Later that year he made the same proposal informally to one of the international scientific groups, while one of his original audience—Dr. Sydney Chapman, an Englishman who has earned world renown in geophysics—carried the same message elsewhere. The whole idea was ap-

proved in 1951 by the International Council of Scientific Unions. The emphasis was extended from the polar areas to the world at large. Therefore, the name of the project was changed from the Polar Year to the International Geophysical Year. Dr. Chapman became chairman of the International Committee of IGY while Dr. Berkner, who is now guiding the Brookhaven National Laboratories, became vice-chairman.

The roster of participating nations burgeoned swiftly. By the end of 1955, 46 nations had volunteered to co-operate. Some 41 of them had already outlined definite programs. Each nation must pay for its own program. The U. S. has already appropriated \$12 million for its effort (as against only \$30 thousand in 1932-33), and this doesn't include some of the satellite research or the supply program for the antarctic expedition. In the global total, at least \$100 million—probably two or three times that figure—will be spent.

The scientific program blossomed briskly. By the end of 1955, the component projects were mushrooming larger and larger each week. Let us look at some of the investigations which, during IGY, will be tied together as neatly as a shock of wheat:

Meteorology: Weather observations will be taken at 265 special stations from the North to the South Pole along three different pole-to-pole lines—80 degrees West, 10 degrees East, and 140 degrees East. Special efforts will be made to get more information about weather in the large, and about the circulation of air at high altitudes. In addition, ten consecutive days will be set aside each quarter during the year and a half of IGY for simultaneous weather observations all over the world. The aim: to learn more about weather patterns in order to make forecasts more reliable, particularly long-range ones.

Solar Activity: The sun is our prime source of energy and domin-

ates activity on earth in many ways, not only through the weather but through radio communications. Sunspots and huge eruptions on the sun's surface, which dwarf the power of our volcanoes, will be studied. In fact, the sun will be under observation from some place in the world throughout every minute of IGY; at least one station will always be ready to pick up the observations as the sun passes from the view of other stations. Changes in its energy output will be carefully charted during IGY. In addition, a series of World Alerts will be held during IGY to speed a world-wide warning to all stations whenever the sun explodes into unusual activity.

Gravity: The strange variations in the force of gravity will be measured, particularly in South America and near both poles where little is now known about this phenomenon. The direction as well as the pull of gravity will be determined at numerous points on the earth's surface. One result: the determination of the exact shape of the earth, which is neither a perfect globe nor perfectly *unsymmetrical*.

Latitude and Longitude Determination: At some 20 stations throughout the world, special tests will be made to pinpoint lines of latitude and longitude. The objective: to locate the exact spot of any point on the earth's surface, as well as to try to determine the shifting of the continents.

Glaciology: Glaciers still cover 10 per cent of the earth's land surface and can be found on every continent except Australia. Two huge glaciers—one in Greenland and the other in Antarctica—exert a great influence on weather, an influence not yet completely understood. Moreover, glaciers can reveal, through the organisms in their various layers, the condition of the climate eons ago and provide a greater understanding of the earth's history. All these investigations.

continued on page 330

MAN LAUNCHES A MIDGET MOON—

How to keep it aloft



This full-size model of a man-made satellite is the first ever constructed. It was put on public display in the American Museum-Hayden Planetarium last December. The parts that went into it, including all the instruments, cost about \$150. It is estimated that to launch 6 to 10 of them will cost \$10 million. The model was built by *Popular Science Monthly* in consultation with the U. S. National Committee of the IGY.

A series of basic discoveries spanning almost four centuries combine to permit the launching of an unmanned satellite

PERHAPS the most exciting event of the International Geophysical Year in the United States will be the launching of about a dozen man-made satellites which unmanned, will travel around the earth at distances of from 200 to 800 miles above the earth's surface. Not much more than 18 inches in diameter, and weighing around 30 lbs., these midget satellites, each with a different "personality," will be launched between July, 1957 and December, 1958.

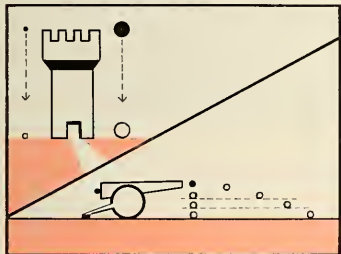
Instrumentation will endow these man-made moons with a "brain" and "voice" so that they can radio back to earth information on the unexplored realm of space. It is also possible that we will be able to catch sight of one of these moons with binoculars, or even with the naked eye, in early evening, if one watches the horizon at exactly the right moment.

Since the dawn of history, man has aspired to throw or project objects into space, and has also desired to learn about the realms beyond his reach. His first pro-

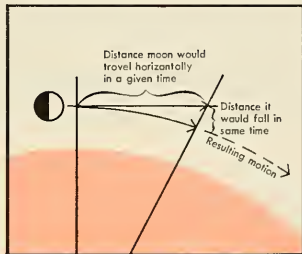
jectiles had a utilitarian purpose—to kill animals for food or to wage war. The spear and the bow and arrow were followed by the catapult and other contrivances. In more recent times, the development of explosives, firearms, aircraft, and rockets has been stimulated by the demand for increasingly powerful weapons of war.

Man's curiosity about distant places has also found expression in a desire to extend his mastery over a wider environment. He has also sought knowledge for its own sake, and in the hope that such knowledge could be utilized for good.

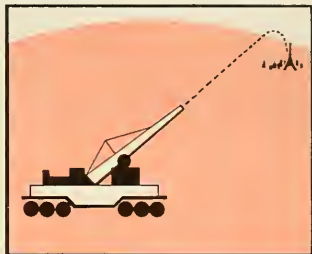
The inventions that have led up to the man-made satellite have combined man's most destructive machinations with his loftiest dreams. In the formulation of the satellite's trajectory we see the genius of Galileo and Newton; in its operation, the taming of elements once considered violently dangerous. Its telemetering equipment, impressive because of its minuteness, is an awe-inspiring manifestation of man's ingenuity.



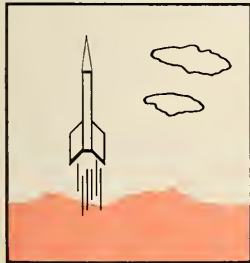
About 1592: Galileo showed that bodies of different weights fall with equal velocities and with uniform gain in speed. Except for air-friction, a 100-pound cannon ball will hit the ground at the same instant as a one-ounce bullet—even when shot from a gun parallel to the earth.



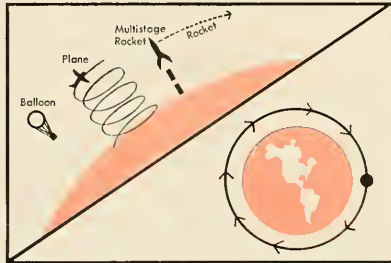
1666: Basing his studies on the conclusions of Galileo, Kepler, and others, Sir Isaac Newton proved that the moon's movement around the earth is the result of its forward motion in a straight line coupled with its tendency to fall.



1918: The powerful Paris Gun sent shells 76 miles from Crepy to Paris. Their peak altitude was 28.6 miles; their muzzle velocity, 3400 m.p.h. This was far less than would be necessary if man were to launch a satellite that would circle the earth.



1926: Robert H. Goddard, founder of modern rocketry, fired the first liquid-fuel rocket, at Auburn, Mass. This was the first step toward the modern high-altitude rockets, which will launch the man-made satellites.



Speed and altitude have been increased by launching rockets from balloons and airplanes. But the first satellite will be lifted by double-stage rocket; then a third rocket will give it high horizontal speed.



Once aloft and moving fast enough, the satellite will continue to travel around the earth. But even at an altitude of 300 miles, slight air-friction will slow it down, causing it to fall and finally burn like a meteor.



John E. Spangler

▲ A CICADA nearing the end of its struggle to reach maturity. The old pupal shell is below. The winged insect has emerged through a slit.



THE Cicada Clock

Let it tell the time for you

By RALPH J. and MILDRED L. DONAHUE

ACCORDING to weather lore, the sound of cicadas betokens frost only six weeks away. This, like many another maxim, has long since been proved a fallacy. Yet, there is at least one tribe of these insects whose transformation from pupa to adult is so regular that we could almost set our watches by it. We refer to the black and green cicada

known to entomologists as *Tibicen pruinosa*, a most common insect of our summer hours.

The schedule these insects follow is so punctual that it appears to be regulated by some sort of sundown signal. Yet just how such a thing could be, in the dark underworld, is something of a mystery, since, from the time they hatch from eggs and

dig into the ground to feed on the sap of plant roots, they never see the light of day.

Around nine o'clock in the evening, which in midsummer is the time of the first darkness, the quota of cicadas for each day digs out of the ground and proceeds to transform almost as one individual. The pupae climb up tree trunks, weed



▲ AFTER SEVERAL YEARS underground, this pupa has climbed up on a stem and is beginning to split its shell. All in a given locality start to emerge at almost exactly the same time.



▲ UNHURRIED, but wasting no time, the cicada is well out of its "old house" within a quarter of an hour. In a few weeks of winged life in the air and sunlight, it will mate and die.



▲ ATTACHED only by the tip of its abdomen, it now swings outward. Its feet make their first unceasing movements; its stubby wings wave, as if to say, "Hurry up! Time is wasting!"



▲ ARCHING its body forward, the new cicada clutches the roof of the old house with its feet. The wings expand, just about fast enough for you to see the movement if you watch closely.



stems, even up the legs of lawn furniture—anything that will give their clawed feet good purchase. They also seek a height that puts them out of reach of earth-bound predators. (Cicada steaks seem dearly loved by many creatures, including cats and box turtles.)

The pupae are most careful in anchoring themselves where they will have a good hold for emerging from their "shell," because the newly emerged are quite helpless and must cling to the shell while their wings harden for flight. Should this support, for one reason or another, become detached before the insect can be off and away, there will be one less singer in the cicadas' summer chorus.

It normally takes *pruinosa* something over an hour to transform completely into the adult form. And since all those emerging each evening progress more or less in unison, we can tell from a single specimen not only the hour but the approximate minute! (Of course, we must know the cicada timetable to be able to tell the time.)

After the pupae have left their burrows in the ground and have selected a place to "park," it is a short five minutes before emergence begins. By 9:05 the shoulder areas of the pupal shell are seen to expand. Presently, if we are close, we may hear a light crackling sound, and the shell can be seen to split from the base of the head down to



▲ TEN O'CLOCK and on schedule. The tip of the abdomen is shrinking. The wings are fully expanded. their milky-white membranes clearer. To see it fully mature, turn the page.



▲ HERE is the adult cicada, a respectable member of the world of winged things. It passed its previous years in darkness yet followed this schedule of emergence almost to the minute.

the lower edge of the thoracic regions—an unzipping process, as it were.

The transforming insect now pushes slowly upward and forward, and the color of its new garment begins to show through the break. Next, the face is freed of its underground mask, and by 9:15 the image of the partially vacated shell and partly emerged cicada looks like an example of photographic double exposure.

By the end of the next fifteen minutes, the cicada is free except for the tip of the abdomen. At this point, the limp form swings downward and backward. The rudimentary wings wave feebly, and the legs, freed of their encasement, move for the first time. After a few minutes of resting in this position,

the soft body arches forward until the feet clutch the upper edge of the old home. Meanwhile, the abdomen has released its hold, and, with wings widely expanding, the cicada awaits the final development.

By ten o'clock, all the cicadas have finished their magic. The wingless dwellers of the dark earth have become iridescent fliers of the treetops. By sunup the next morning, the new creatures are ready to join in the activities of those that have emerged before them. The males will add their songs to the summer chorus; the females will lay their eggs under the bark of trees in subterranean tunnels will be unremembered in the comparatively short span of winged existence that Nature awards them.

The Tree

THOSE of us who live in the American Southwest may think we know something about the strange plants that deserts can produce, but a glance at this weird specimen will surely put us in our place. It is from Angola in South West Africa, and it can be seen in the Chicago Natural History Museum.

Its awesome scientific name is *Welwitschia Bainesii* (Hook f. Carr), and it has no immediate relatives, living or fossil, so far as any one knows. It is "a highly specialized survival of an ancient stock and as such may well be called a relict," to quote B. E. Dahlgren, Chief Curator of the Department of Botany at Chicago's Museum.

That such a flat plant could be a tree is hard to believe, but the central portion is the woody trunk. It stops growing upward as soon as it produces its first pair of leaves. Then it starts to grow sideways, increasing its diameter until the circumference may measure as much as fourteen feet. The leaves continue to grow nonetheless and are able to keep pace with this expansion because they are sheathed at their bases. Dr. Friedrich Welwitsch, who discovered the tree, described it as looking "like a round table a foot high projecting over the sandy soil." The leaves, which are often six feet long and almost half as broad, split up into numerous ribbons at the ends.

As the tree matures, it produces each year a number of small forked branches at the base of the leaves. Those on the male plants bear staminate catkins, while those on the female plants bear the larger, greenish-crimson, cone-like, seed-bearing structures. These have en-

What isn't a Tree

By ELIZABETH RIGBY

It grows sideways instead of up and can apparently go ten years without a drink

abled botanists to classify this contradictory dwarf as belonging with the Gymnosperms or naked seed plants, of which conifers and that living fossil, the ginkgo tree, are more familiar examples.

The seed of one of these Welwitschia trees was planted at the Royal Botanic Garden at Kew,

England, in 1880. Thirty-six years later, it was still living, though the Garden's curator commented that growth was so slow that a full-sized plant might, at the rate that one was going, be reckoned a thousand years old.

In its native haunts, the tree survives the dry years as many

other desert plants do, by storing water in its own tissues. This tough old survivor from an earlier era has been doing pretty well, considering what it has had to put up with. Conditions in its Mossamedes Desert homeland are really tough. Ten years may pass there without a single drop of rain.

PROFESSOR H. HUMBERT of the Jardin des Plantes in Paris, standing beside a Welwitschia tree. The specimens he collected for the Chicago Natural History Museum in 1946 are believed to be the only ones to be seen in this country.

SURVIVING in only two isolated desert regions in Portuguese South West Africa, the Welwitschia tree is one of the oddest on earth. The protuberances seen near the base of the leaves in this photograph are the seed-bearing cone-like "branches" usually put forth by the female plant.





Circle Cliffs

Spectacular desert scenery rewards the traveler who ventures into this little-known area in south-central Utah

By JOYCE ROCKWOOD MUENCH

Photographs by JOSEF MUENCH

MOTORISTS traveling westward toward Bryce Canyon on a dirt road euphemistically called Utah State highway 24 are advised by their road map to carry their own water. Some will feel that the

threat of a breakdown on this thirsty route offers thrills enough. Others, who are tempted by uncharted territory, will look southward toward the wilderness of Circle Cliffs and perhaps have a try

at it. But they will probably soon agree with the leader of a nineteenth century expedition that it is a land "no animal without wings could traverse."

Josef and I had seen this region

▼ A VIEW EMBRACING the two most distinctive attractions of Circle Cliffs. Right foreground: a large petrified log. In the background: part of the encircling cliffs, with Boulder Mountain in the dim distance.



from the west. Viewed from the slopes of Aquarius Plateau, it looked like a particularly rough relief map, in full scale, but its very ruggedness lured us. We hoped that sooner or later the uranium prospectors who were scouring the whole area would find or make a way to get in.

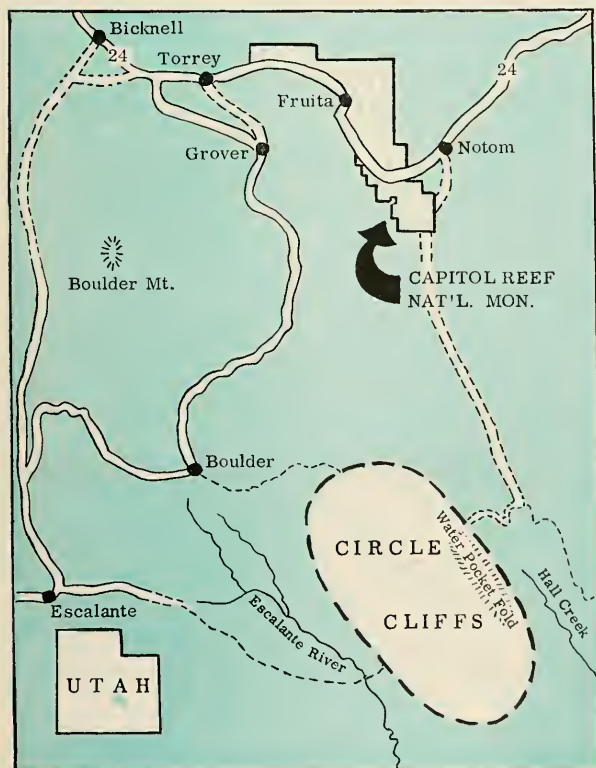
On the east, the stronghold of Circle Cliffs is guarded by the irregular upthrust of Waterpocket Fold, which extends for more than 25 miles. From the south, the Canyon of the Colorado bars access. From the west, approach is made difficult by the winding channel of the Escalante River and the canyon-broken terrain of its eastern tributaries.

We rejoiced when one day our friend Lurt Knee wired us that he



▼ THE MAP BELOW will aid the adventurous to find their way to Circle Cliffs.

▲ ONE of the so-called demoiselles that are abundant in the region. The harder cap rock has protected the softer material beneath. In the background we see again the encircling cliffs.



▲ LURT KNEE, experienced desert guide, who says his chest-type Geiger counter leads him to fine scenery as well as to uranium.



▲ BECAUSE of its resemblance to a monarch's crown, this finely sculptured battlement has been called The Diadem.

believed it possible to make a trip into Circle Cliffs. Lurt Knece's headquarters are at his Pleasant Creek Ranch, at the edge of Capitol Reef National Monument, from which, as an experienced desert guide, he takes parties into the surrounding country.

We hurried to meet him and set out from Torrey in two jeep station wagons. We went over the shoulder of the mountain on State Route 117 to the town of Boulder and then tackled the primitive trail that led toward our goal.

The cars battled through sand, over slick rock, and climbed through Long Canyon to the north-west rim of the cliffs. Our reward, at sundown, was a panorama of the vast wilderness to the east. And we were delighted to see also a clay slope down which we could switch-back right into the magic circle.

I don't recommend the route. More feasible for the average car is to leave Route 24 at Notom and travel 29 miles southward on good desert road to meet the already improved Burr Trail. This is maintained for mining operations in the vicinity, and it winds up a 900-foot rise to breach Waterpocket Fold at



▲ THE LAMPSTAND, a residual mass isolated by erosion in the wonderland of Circle Cliffs.

Mule Twist Canyon. Barring heavy summer rains, there is a good chance to get into Circle Cliffs by this route from late spring till fall.

Once in, it is no easy matter to move about, for the 10- by 30-mile

oval area is by no means as flat as it looks from above. Buttes, mesas, and peaks rise from a labyrinthian system of minor canyons that give it the look of a miniature replica of the entire Colorado Plateau.

▼ THIS PETRIFIED STUMP appears to have grown on this spot, whereas most petrified trees have been uprooted, and many have been floated away from the place where they stood.



CIRCLE CLIFFS

▼ THIS FOREST GIANT grew in southern Utah when the climate was moist, but now it is turned to stone.





▲ THE EXPLORERS drove the two jeep station wagons out via Silver Falls Canyon, shown here. The gorge had its beginning in this dry, alkali-whitened stream bed, but it grew narrow and winding.

▼ ONLY VEHICLES with four-wheel drive can negotiate Silver Falls Canyon, and then only when the weather is dry. The canyon gets its name from the countless ribbons of silvery water that pour over the red cliffs in times of rain.



Rocks of the so-called Moenkopi beds have been exposed throughout most of the bottom of this vast oval. Geologists have concluded that these rocks were laid down under a large body of water at about the beginning of Triassic period, perhaps 200 million years ago.* Where the Moenkopi rocks are exposed in the Circle Cliffs, their dominant tone is reddish-brown.

Petrified Forests

Remnants of ancient forests turned to stone have been uncovered by erosion here and there. We located three separate areas of prostrate forests, and our pictures of them may be the first ever taken. In extent, they possibly rival even the well-known Petrified Forest of Arizona. We measured logs up to 10 feet in diameter, and some of the exposed lengths were about 150 feet. The tree trunks criss-crossed one another as though in vast log jams.

One "forest" we called Fallen Giant Forest, was partially hidden beneath the overburden of rock, yet a great many petrified trees were in evidence. Some of them bridged small canyons, others protruded from caves, and tiny fragments of many-colored stones provided a sparkling pavement for the ground between.

On another day, after walking weary miles, we examined Picture Wood Forest. Here we saw some of the most beautiful petrified wood. It showed designs in vivid tints which the imagination could easily transform into sunsets and sylvan scenes.

But our most exciting find was Toadstool Forest, where a giant hollow stump some 8½ feet tall and 10 feet wide appeared to be standing just where it had grown. All around it were mushroom-shaped rock formations, some examples of which are shown in the accompanying photographs. While the petrified wood displayed some of the

*The Kaiparowits Region, by Herbert E. Gregory and Raymond C. Moore, U. S. Geological Survey Professional Paper 164 (1931).



▲ OUT OF CIRCLE CLIFFS, the expedition found a spectacular route through Harris Wash to Escalante.

characteristic reds, blues, greens, oranges, and contrasting white tones, the color of the trunks here was predominantly so dark as to justify our calling them The Black Forests of the Circle Cliffs. Other forests of petrified trees probably lie around the base of the great circle, and no one can guess what other sights may await the adventurous traveler.

We departed by way of an exit through Silver Falls Canyon, and it was no anticlimax. Scarcely anywhere has the spacious architecture of the Southwest been more marvelously developed than here. And we had ample opportunity to study the landscape from various angles as we searched for the way out. We finally found the trail to the South Fork of Silver Falls Canyon. It began mildly as a shallow dry

stream bed, whitened by alkali. But within a mile, the descent steepened. The walls reared above us on either side, and big boulders filled the narrow cut. Only because a caterpillar tractor had been through since the last storm were we able to maneuver the jeep station wagons through. We continued down the gorge at water-level grade, twisting and turning into successively larger and deeper amphitheaters of rock.

It was easy to imagine how, after every rain, curtains of water would flow down the unscalable cliffs on either side to render the route impassable. Sometimes the sandstone walls almost arched together overhead, and we hurried past the overhanging rocks. There were shadowy chambers where the sun never touched the ferns and pale monkey

flowers. But as we approached the Escalante River, the canyon floor widened, making a level roadbed of sand, some of which was treacherously "quick." The river was shallow enough to offer no trouble in crossing. Just beyond the mouth of Silver Falls Canyon, Harris Wash continues on with the same expansive scenery. It was, if anything, even more grand as it lifted gradually toward Potato Valley and Utah State Route 23 near the town of Escalante.

Driving back with our guide across the shoulder of Boulder Mountain and looking down into the great basin, it was hard to believe we had been able to penetrate that vast confusion of cliffs and canyons. But we advise you not to try it without a four-wheel drive!

WHAT I.G.Y. WILL DO (continued from page 317)

plus an assessment of the glaciers today, will be pushed in IGY.

Airglow and Aurora: The garish curtains and streamers of light we call the aurora borealis and aurora australis, play a significant role in jamming radio communications. They are produced by the excitation of gases high in the atmosphere, a process similar to that which takes place in a neon sign. During IGY, the timing and location of these phenomena will be studied, as well as the ionization process that gives birth to them. One aim: to help find ways of forecasting aurora displays, thus permitting the rerouting of radio communication that otherwise would be jammed.

Oceanography: Three-fourths of the earth's surface is water—the refuge of many mysteries of nature. Why are trillions of tons of arctic water suddenly dumped into tropical seas, causing great upheavals in the sea and in the atmosphere overhead? During IGY, scientists will try to find the answer to this question through a study of the motion of the sea at very deep

levels. They'll also explore changes in the level of the sea and shifts in the tide. Some 30 stations, several at sea but most of them on islands, will be set up to unlock the secrets of the sea.

Seismology: Though man is helpless in the vise of earthquakes (some 3000 tremble through Chile in an average year), he can take steps to predict their course and severity. Furthermore, earthquake waves give clues to the structure of our planet. IGY scientists will study the cracks in the earth's surface and the places where great strains slowly gather force. Also under scrutiny will be the antarctic and certain Pacific isles never before studied by seismologists. The point: to remove man from the grip of the earth's caprices and to tell him of its internal composition.

Geomagnetism: The atmospheric blanket surrounding the earth contains a magnetic field that erupts in massive storms affecting most navigational instruments—or at least their use—as well as many communication devices. Especially

susceptible are short-wave, long-distance radio circuits. During IGY, fluctuations in the magnetic field, as well as the extent of the field, will be more fully explored. The purpose: to find out more about the relations of the magnetic field with such other phenomena as cosmic rays, the ionosphere, and the aurora.

Ionospheric Physics: Fifty to 250 miles above the earth stretch layers of ionized gas. Because they reflect radio waves, they make radio communication possible. Though we use the ionosphere with considerable effect, there is much we must learn about it, particularly above remote areas of the earth. The aim: to remove some of the uncertainty of radio communication and find new uses for the ionosphere.

Cosmic Rays: Surprisingly little is known about cosmic rays—but we do know that they are valuable sources of research into the atom. They are simply fragments of atoms, traveling at incredible speeds, which bombard the earth from all directions. Frequently, they reach an energy level that overshadows what our man-made

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atom smashers generate. Their direction of approach and their intensities at various places can tell us much about the outer space they have traversed. During IGY, a general, sustained attack on the mystery of the cosmic rays will be made, to learn more about the rays themselves and about the character of the space of our galaxy.

Exploration of the Upper Atmosphere: During IGY, at least 600 rockets of different types will be fired into the upper atmosphere for a great variety of reasons—for studies of meteorology, cosmic rays, geomagnetism, the ionosphere, solar rays, and X-ray absorption in the high atmosphere. Instrument-carrying rockets will be fired from ground and ship stations as well as from high-flying balloons. They will reach, at their peak, a point about 200 miles above the earth's surface.

One part of the last project has implications greater than IGY itself—the satellite program. The political overtones were illustrated when the U. S. satellite program was announced last July 29. Within a few days, the Soviet Union announced that it too would launch a satellite, without proposing, however, that it be included among the scientific studies of IGY. The scientific overtones are enormous: the use of earth satellites offers a whole new avenue for the exploration of our geophysical environment. When the satellite plan was announced, Dr. Berkner compared it with the first flight of the Wright brothers.

"They took the first step by getting us into the air," said Dr. Berkner. "The satellite will provide the second step by going beyond the atmosphere into space."

When the program was first announced, it was thought that a single satellite would circle the earth at a height of 200 miles and a speed of 18,000 miles per hour. Now twelve satellites may be launched during IGY. Two or more may be launched simultaneously to circle the earth at a height of 200 to 800 miles. Some may girdle the equa-

tor, others the poles, and still others will slant across the equator at various angles.

The satellites will be self-destructive. As they slow down because of friction in the tenuous outer atmosphere, they will gradually fall back toward the earth. Eventually, they'll hit the thick blanket of atmosphere and burn into dust. But before they do, they will provide valuable information of an unprecedented sort—information that the U. S. will give to all the nations of the world. This gesture is in the spirit of IGY—but it is also eminently practical. "Once you get a satellite up there," says one geophysicist, "you can't hide it. Anybody who can see it can get a certain amount of information from it."

IGY is also providing the stimulus for crashing through the world's last earth-bound frontier—the antarctic. Scientists know less about this huge continent, larger than the U. S. and Europe combined, than they know about the face of the moon. Some think they've spotted mountain peaks higher than Mt. Everest. Some feel that, because coal lies beneath the sheath of ice, vegetation once thrived there. It is certain that useful minerals will be found in usable quantities in the exposed mountain areas and perhaps beneath the ice.

Many meteorologists suspect that the antarctic is the reservoir of some of the world's freak weather. The antarctic is the coldest area on earth, and above its high plateau hovers an accumulation of cold air that is "like a mass of shivering jelly." When a portion of this extremely cold air mass breaks off, it goes careening down the mountain slopes and on to the equator, scattering frigid weather in its path. Finally, if it locks in a gigantic clash with warmer air masses, its effect can spread up over South America as far as Buenos Aires or even Rio.

For more than a century after its discovery, Antarctica lay in dormant isolation. Only ten men ever stood at the South Pole. During

IGY, fifteen men are expected to be in residence at the South Pole. The nations that so long ignored the antarctic are now tripping daintily over themselves to get a foothold on the continent. At least a dozen nations are planning bases and expeditions. The U. S., with six bases, plans the largest effort. Already the U. S. Navy has moved equipment and supplies to the cold continent.

Some persons fear that the antarctic expeditions will degenerate into a political exercise. Only hours after the Soviet Union belatedly announced that it was planning a base at a particularly strategic spot on the coast of Antarctica, four other nations made similar claims on the same area. "But thus far," says one of IGY's planners, "the antarctic expeditions have been designed for the demands of science rather than the demands of politics." And the expeditions of twelve nations have planned intimate joint scientific activities to maximize our comprehension of the area and its effects on the world.

A series of antarctic conferences have laid down plans for the setting up of a "Joint Weather Central" at Little America to assemble data from all of the bases and field parties. Daily weather maps will be drawn and the information transmitted to all stations. Likewise, a common communications system for the entire antarctic area is planned and is already partially in operation. The nations have also agreed on mutually supporting efforts in case rescue work is necessary, and they will join in assembling the transits over the continent that will enable the thickness of the icecap to be measured.

In Antarctica, as in space, there is a tingling expectation of new things to be found, new discoveries to be implemented. That is the spirit of IGY—the anticipation of great mysteries that can be solved for the benefit of mankind. Meanwhile nature is waiting, enigmatically if not demurely—waiting to be asked the prime questions in order to provide the vital answers.



The Screen

Authoritative comments on films in
the field of nature,
geography, and exploration



The Animal World

Reviewed by BOB SCHAEFFER
Associate Curator of Fossil Fishes
The American Museum of Natural History
and

DOROTHY GOODWIN
Film Editor

THE ANIMAL WORLD is Warner Brothers' technicolor effort to depict the history of animal life from its beginning more than a billion years ago to the advent of man. The film opens with a few scenes of prehistoric life made possible by the use of animated models, but the major part of the film consists of excellent shots of living animals in their natural habitats.

Some effort has been made to show the development of animal life through time,

but protozoa, starfish, extinct sea scorpions, modern fish, ancient amphibians, dinosaurs, and modern mammals, including man, follow one another on the screen without any clear explanation of how each fits into the parade of life. As might be expected, 82 minutes of unrelated scenes of animal life result in a film that tends to produce a restless, satiated audience halfway through the picture.

There are a number of scenes that will perturb the informed and confuse the uninformed. Although the commentator explains that man did not exist at the time, a dinosaur is shown attacking a man. Such a scene has no place in a film that is presumably based on fact. The part on mam-

mals, which includes nothing about their history, is a grand pot pourri with no attempt to segregate these animals according to kind, or place of habitation.

On the credit side must be mentioned the beautiful underwater shots in color of the many denizens of the sea.

The American Museum of Natural History is thanked in the credits for permitting a few of the scenes to be taken in its halls. It must be made clear, however, that the Museum did not give any technical advice during the production of this film. *The Animal World* cannot be recommended to anyone who desires a meaningful portrayal of animal life and its history.

YOUR NEW BOOKS continued from page 287

bear. In the summer narwhals (small 10- to 15-ft. whales), were harpooned.

November to March is the cash crop season for the Baffin Land Eskimo. Most of their time is then spent tending the long trap lines. In the dark, winter months stars, occasionally the moon, and the aurora provide the light by which the men travel and work. Then seals are taken by hanging nets beneath the thin ice that forms over leads. This is cold, wet work that must be done with the bare hands.

Obviously Doug Wilkinson enjoyed being schooled in the technique of living like an Eskimo. In the process he gained considerable insight into the problems that face these people as they modify their old way of living under the pressures of Western civilization. *Land of the Long Day* is not only an entertaining story of adventure told without false elaboration but a sound ethnological study.

JAMES A. FORD

LIONS, TIGERS, AND ME

----- by Roman Proske

Henry Holt, \$3.95
317 pp., illus.

ANYONE who likes the circus will enjoy reading this story of an animal trainer who has been a headliner in his field and has had an exceedingly adven-

torous, successful career training lions and tigers. The honesty displayed by the author in revealing his shortcomings removes any element of boasting from his story.

It is of interest to note that there is a marked individuality amongst wild animals and that sometimes the friendship between a trainer and his pupil becomes strong enough to overpower inherited instincts; obedience and even affection can come from this friendship.

There are many incidents of savage attack, bloody incidents, and violent death in this book. For some readers these passages may prove shocking, but since wild animal acts appeal to the public in direct proportion to the element of hazard to the trainer, the story could not present a clear picture without giving details of this sort. The reader will marvel at the daring of a man who exposes himself to the very real dangers described, and he will wonder even more at the powers of survival that pulled Proske through so many savage attacks. One may be pardoned for suspecting that circus stories lose nothing in the telling, but after making due allowance for this, the straightforward style of the author leaves the impression that there is little exaggeration in this book.

The good halftone illustrations capture the spirit of the circus.

HAROLD E. ANTHONY

MAN UNDER THE SEA

by James Dugan
Harper, \$5.00
332 pp., 32 plates, 23 drawings

MAN AND THE UNDERWATER WORLD

by Pierre de Latil and Jean Rivoire
(Translated from the French by Edward Fitzgerald)

G. P. Putnam, \$5.00
392 pp., 18 illus., 55 figs.

ALL those who have cast a fishing line seaward, donned a mask and peered into the sea, or sat at its edge and marvelled at its magnificence, will be fasci-

nated with these accounts of underwater exploration. In these two books are found the history of man's success and failure to probe the inner secrets of the deep.

In Mr. Dugan's book, perhaps the more interesting of the two, personal interviews with those concerned have helped the author to trace, in very readable style, the wondrous story of man's attempts to penetrate the waters of the world. Among the numerous topics covered are ancient free-diving practiced by the sponge divers, and the physiology of diving, which culminated in the discovery of the cause of the "bends." The development of submarine warfare was fascinating reading, particularly the accounts of naval engagements and heroism in the Pacific. The evolution of underwater photography is recorded from its inconspicuous beginnings to the enormous popularity it enjoys today. (Few people realize that *Twenty Thousand Leagues under the Sea* was filmed underwater as early as 1915.)

A separate chapter is devoted to each topic covered in the book, making it convenient for use as a reference work. The illustrations are excellent and the book is well indexed; a chronology of major events in undersea exploration and a bibliography adds to its value. Thus this is an interesting and informative study of the subject.

In contrast to Mr. Dugan's book, which is world-wide in scope, Messrs. de Latil and Rivoire have limited themselves mainly to historical undersea exploits which took place in Europe. Mythology and ancient folklore on the subject are broadly treated; many discrepancies between the reports of ancient writers demonstrate how questionable such accounts are as a source of information.

Other subjects covered include the evolution of the diving suit, the development of modern free-diving, pearls and pearl diving, plumbing the oceanic depths, and the archeological discoveries made by the Cousteau team on the *Calypso*. The authors' own underwater experiences make for spell-binding, stimulating reading. Unique engravings and drawings—many humorous—are skillfully sprinkled throughout the book.

EVELYN SHAW

Letters continued from page 281

This is not strictly accurate, for my records show that the fish was collected once in 1949, twice in 1950 and 1953, and once in 1955.

L. GLAUBERT
Director

West Australian Museum
Perth, Australia

Arnhem Land Art

SIRS:

May I state that your article on the aboriginal art of Arnhem Land (March, 1956) is one of the most concise and enlightening on the subject it has been my pleasure to find in many long years of interest in Australian native life.

FRANK BAKER

Hollywood, Calif.

Middle Eastern Nomads

SIRS:

I have read *NATURAL HISTORY* for many years with great pleasure, and through its pages, have learned many things that have increased my enjoyment and appreciation of the outdoors.

As I have long been interested in nomadism, I read the story, "The Big Trek" in the May issue with especial interest. In this connection it is interesting to note the existence of two "Neutral" zones, so marked on maps, between Iraq and Saudi Arabia, and Kuwait and Saudi Arabia. These zones make it possible for nomads of all three countries to graze their flocks in these diamond-shaped, 50-mile tracts in the spring, without crossing national boundaries!

DOROTHY WYNNE

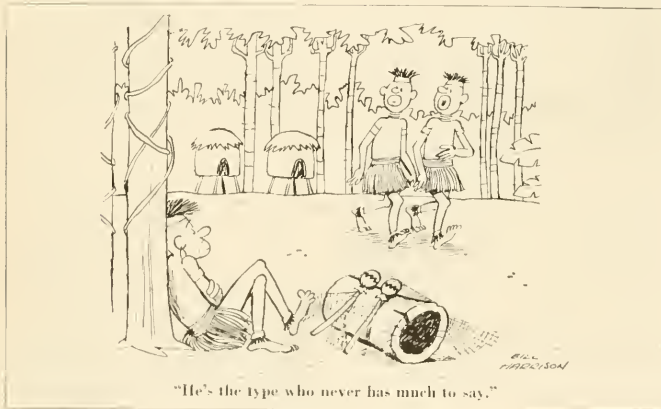
New York, N. Y.

With the Explorers

The Fifth Archbold Expedition has begun the task of collecting specimens of plants and mammals on Normanby Island in New Guinea—an inhabited island where not a single mammal has ever been collected for scientific purposes.

The overall aim of the Archbold Expeditions is the study of the geographical and ecological relationships of the animal and plant life of New Guinea, Malaysia as a whole, and Australia, and to shed further light on the question of previous land connections between these areas. The expeditions are headed by Leonard J. Brass, Associate Curator, Department of Mammals, the American Museum, and sponsored by Richard Archbold, Research Associate of the American Museum.

Previous expeditions were noteworthy. The 1953 one to eastern Papua returned with 85,000 zoological specimens. The 1938-39 expedition to the Snow Mountains area of Dutch New Guinea discovered and explored the "Shangri-la" valley of the Balim River.



"He's the type who never has much to say."

Elk Range Limited

It is of interest to learn that the elk herd of Yellowstone National Park has been growing so fast that it was recently found necessary to reduce the herd to a number that could be supported by the Park's ranges. Some 650 elk were trapped in pens inside the park and shipped alive to restock ranges in Montana and New Mexico. The long-range goal of the program is aimed at maintaining a herd of about 5,000 elk on the northern Yellowstone range. This is the approximate number the winter range can properly support.

Wildlife Stamp

Our readers will be interested to learn that for the first time an American game animal is to be pictured on a U. S. postage stamp. It is the wild turkey, depicted in flight. The artist, Robert W. Hines, chief artist for the U. S. Fish and Wildlife Service, is one whose work is familiar to readers of NATURAL HISTORY.

Study Tour of Mexico and Central America

Fifteen students and teachers can make a five-week field trip to study the culture and history of Mexico and Central America this summer. The trip, organized and sponsored by the American Museum, is under the supervision of a trained expert. As the tour has the endorsement of the New York City Board of Education, teachers making the trip will be entitled to receive six points of in-service credit.

National Park Visitors

Over fifty million people visited the national parks in 1955! This represents an increase of two million over the total for 1954, and was due, in part, to a number of improvement projects initiated in 1955.

Speaking of improvements — National Park Service Director, Conrad L. Wirth has announced that fewer forest fires occurred in 1955 in areas administered by the National Park Service than in any of the previous twenty years!

American Mountain Climbing School

A proposal has been sent to Congress by the Department of the Interior that would authorize the establishment of a mountain climbing school in Grand Teton National Park, Wyoming. The school would be run by two of America's foremost mountain climbers — Paul Petzoldt and Glenn Exum.

Insect Recordings

Although, strictly speaking, the insect has no voice, the music (?) of crickets, grasshoppers, and cicadas — buzzes, trills, chirps, and lisps — is now available on a new record produced by Cornell University Records, a division of Cornell University Press.



From Don Knight

▲ FISHING in California's Merced River: a photograph by Ralph Anderson

stance, may be allayed by beating out the campfire with a stick of bamboo.

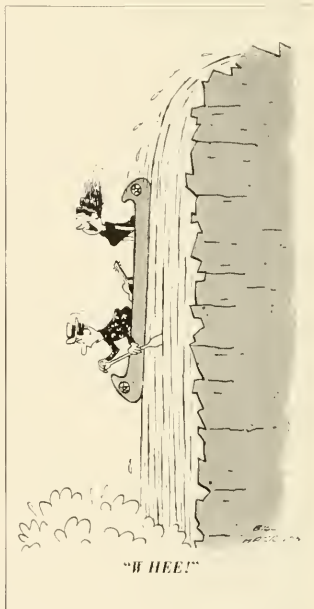
After we had been with the Phi Thong Luang several days, we prevailed upon them to perform their sacrificial ceremony, using a pig which the expedition provided. After the pig had been killed, a bit of its blood was caught in a large leaf and given to an elderly man. He remained seated upon the ground and repeatedly wiped the blood across the point of a spear. In a low voice, he directed lengthy incantations to the spear spirit. As soon as this phase of the ceremony was completed, the pig was dismembered; and each person, grasping a piece of raw meat, walked around the old man in a circle and waved the meat in the air, inviting the ancestral spirits to come to the feast. The elderly man remained seated and seemed to be inviting the ancestral spirits through more formal incantations.

The pig meat was then placed in large sections of green bamboo over the open fire. As soon as it was partly cooked, it was removed and carefully placed upon a small bamboo platform that had earlier been woven and erected under the front center of the lean-to. It was left there overnight so that the spirits could feast upon it, and what was left the next morning was removed and shared by the clan.

The entire ceremony required about four hours, and owing to the weather, we had great difficulty in photographing it. The rainy season was fast approaching, and large cloud formations were continually casting shadows across the campsite. Dense bamboo formed a heavy canopy blocking the sunlight that was necessary for our color photography. We spent several hours climbing tall bamboo stalks and cutting off the tops so as to admit the necessary illumination.

We found the clan suffering from malaria and yaws. Easily administered therapeutic doses of the antimalarial Chloroquin sufficed for

the men and the child, but the woman was severely afflicted with yaws and was difficult to treat. Skin lesions covered a substantial part of her body, and each one was open and septic. They varied from half an inch to an inch and a half in diameter, and large swarms of flies were finding an ideal site for depositing their eggs. Each lesion possessed its share of fly eggs and maggots. The removal of the eggs and the cleansing of her body was made additionally difficult by the



rancid odor. After cleansing her and dressing the lesions, penicillin was administered and a high protein diet started. Within a week's time, the entire clan was well on the road to recovery.

Such a sudden change in their health should have shifted their confidence from their ancestral spirits to the modern medical assistance we had given them, but instead they amazed us by explaining that our strange appearance had frightened the ancestral spirits away, enabling them naturally to regain

their health. Our modern drugs received no credit whatever.

The tenth day of our stay with the Yellow Leaf people disclosed that we had expended our entire supply of film and recording tape. Further, the elan members were impatient to push northward before the monsoon season should descend in full fury. We wanted to join them again at their wet season campsite and to continue the documentation, so we arranged for as definite a rendezvous as was possible, considering our limited ability to communicate with them. We were to find them in a deep forest along a tributary of the Nam Nan River approximately "one moon" later.

In due time, having replenished our supplies, we again headed north. We continued to a point on the Nam Nan River about 50 miles farther upstream than we figured the people could have reached in the elapsed time. There we obtained a large dugout and started downstream.

We encountered many tributary streams and searched the valley of each one. There was no sign of the Phi Thong Luang. We continued the search down about 80 miles of the Nam Nan. The wet season was by now producing dangerous rapids. The river was rising rapidly to its flood stage, and since the banks were steep everywhere, it was hard to find spots to camp. One night the water rose so rapidly that when we awoke in our hammocks, three feet of water was running through our equipment shelter. When daylight came, we were still floundering through high muddy water searching for valuable pieces of equipment.

We realized that by now our primitive friends would have established themselves in a secluded spot, safe from native hunters. The heavy rains would quickly destroy any signs of their movement, so we gave up the search. The Spirits of the Yellow Leaf had faded from sight—possibly for all time.

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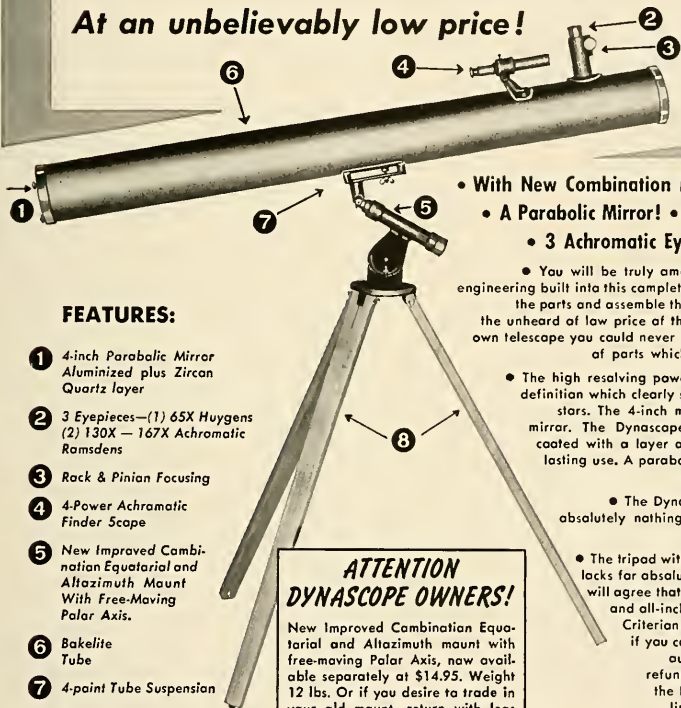
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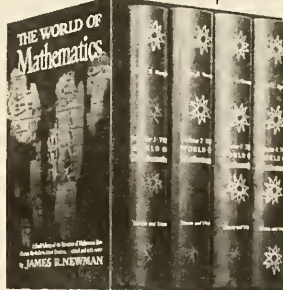
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Navaho Rug Weaver

From a color transparency by Josef Muench

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THE COVER THIS MONTH

Perhaps no article produced by American Indians is so well known to the general public as the famous Navaho rug. Far from being an ancient and traditional handicraft, however, the beginnings of Navaho rug-weaving may be dated as recently as 1890.

The art of weaving in cotton was first learned by the ancestral Navahos from the Pueblo Indians of northwestern New Mexico during the late seventeenth century. Somewhat later the flocks of sheep introduced into the southwest by Spanish settlers furnished the Indians with a supply of wool, but the articles woven were limited to wearing apparel and to saddle blankets. It was the white trader who first realized the commercial possibilities of the Navaho rug, and who stimulated Navaho women to weave a product that would appeal to the American market. At first he supplied the yarns, the dyes, and even suggested appropriate patterns.

On this month's cover a Navaho weaver sits before a loom of Pueblo origin, weaving with wool of Spanish introduction, a rug designed to appeal to modern American tastes.

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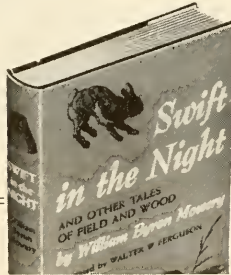
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NEW LIVES FOR OLD

----- by Margaret Mead

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548 pp., 16 plates, 3 figs., 4 appendices

IN 1928 Margaret Mead, a youthful alumna of Franz Boas's school of social anthropology at Columbia, but already a veteran field worker, went to Manus Island, a 600 square-mile patch of rock and jungle off the northeastern back of New Guinea. Geographically and culturally Manus forms the western anchor of the Admiralties group. Its inhabitants were divided into three geographical and cultural segments—the Manus themselves, boat-people living in villages built on piles off the shore of the main island; the Usiai, inland bush people; and the inhabitants of the smaller islands, including the Johnstons, Bahian, and Rambuton, which fringe Manus twenty to forty miles to the south and east. Of the three thousand natives of this territory the Manus themselves, numbering two thousand, occupied 13 stone-age Venices, and spent their lives in, on, and over salt water.

Dr. Mead and her field companion, Dr. Reo Fortune, produced, in several volumes and articles, a thorough study of these people, which, in various successive publications, has become, in Europe and America, one of the stock examples of a specific pre-literate culture used in teaching anthropology, sociology, and psychology. Without their own cognizance, the Manus have become as well known to many students as the Eskimo, the Athenians of the Golden Age, or the Jukes and Kallikaks.

In 1953 Dr. Mead returned to Manus, this time accompanied by a gifted young husband-and-wife team from the University of Pennsylvania, Theodore and Lenore Schwartz. With all sorts of techniques and devices invented or improved since 1928 they took tape recordings, somatotype records, projective tests and other data yet to be processed, to appear under the names Mead and Schwartz. *New Lives For Old* is partly a preview of some of these results.

Between 1928 and 1953, Dr. Mead found, the Manus had passed from the Neolithic to the Atomic Age without the intervening cultural steps which cost our ancestors 5000 years of steady progress, and they had made this transition successfully. How they did it is the subject of this book. Fifty years ago the Manus

lived in a group of independent pile villages. Having no source of raw materials but the sea, they fished. Trading their surpluses with the island-dwellers they obtained vegetable foods, clay for pottery-making, and virtually all of their tools, ornaments, and other material possessions. Sailors and sharp traders, they had established currency in the form of shell-beads and dog-teeth.

Like other seafaring peoples whose men leave their women behind when they embark on long and perilous voyages, they had developed a rigid social system with a high price for brides and much sexual restriction. Young men fell into debt to older kin over bride-price loans, and some husbands paid off these obligations and became bride-bankers in turn, while others remained in permanent financial servitude. Up in the rafters, the skulls of recently dead ancestors supervised the rectitude of these activities with sharp if invisible eyes and imposed harsh magical sanctions on breaches of the sexual code. On Manus life was tough, tight, grim, and complicated.

To the setting of these miniature maritime empires came in turn Captain Cook, the Germans, the missionaries of several faiths, the Australians, the Japanese, the Americans, and again the Australians. Today the Manus wear clean white duck shorts and sometimes shirts and neckties. They are becoming literate in Neo-Melanesian (a polite name for pidgin English); they have moved to the shore where they have built new villages, have tossed the skulls of their ancestors into the sea and have slacked off their marriage regulations, while governing themselves democratically, as a single group together with the bush-people and the off-islanders, under Australian supervision.

From each of the invaders who contributed directly or indirectly to this process the Manus learned something—about technology, human relations, and the size of the world. At one time they had their own messianic cargo cult (you believe that a ship full of treasures of all kinds is about to arrive, but it won't come unless you get rid of all your present possessions first); later they were led by a living culture hero, a Manus version of Quetzalcoatl, Osiris, and all the other culture-bearers rolled into one. His name is Paliau, and his well-groomed person is the subject of several photographs in the book. To explore the anatomy of genius, the Mead-Schwartz

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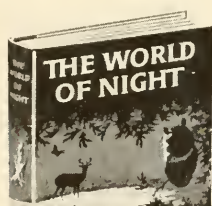
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"These two know their stuff and are among our most skillful writers on natural science."—EDWARD WEYER, JR., editor, *Natural History Magazine*

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team tested him in every possible fashion. Out of his own brain Palian devised the New Way, the Atomic Age culture of Manus.

Without implying any discredit to Palian, one is led to wonder if it is not easier for a culture-hero to transform the culture of a few thousand persons living in a spot like Manus, than to renovate the way of life of several millions inhabiting a permanently strategic area like the Nile Valley and the flanks of the Suez Canal? What would Palian's genius have availed him had he been born in Nasser's shoes?

Despite these natural queries, we must grant that from her narrative Dr. Mead has appeared to derive principles of culture change of global application. She has de-emphasized the Dewey-era and dewy-eyed idea that how children are brought up determines their cultural behavior as adults, and decided that culture is transmitted from adult to adult without reference to infant training. She has made a clear and wise statement about the causes of race prejudice which includes biological as well as social factors: "the core of the race problem in the United States is the question of visibility; to be an American is to choose to be like other Americans, and this is more difficult the less you look like the other Americans." Also: "... social differences in the United States are maintained by women."

These statements are a far cry from the attitude of the Boas school twenty year ago. Today Margaret Mead is a whole school of her own. She has shown a capacity to learn and to grow, and the courage to change her mind. Alongside, and fuelling all this, she has retained undiminished her priceless secret weapon—a miraculous, endless store of energy and euphoria which, with her other gifts, have made her the *grande dame* of American social anthropology. Wherever she goes next and whatever she discovers, she will continue to carry these assets with her—a one-woman good-will tour. Perhaps Palian should write a book about her.

CARLETON S. COON

The author of numerous books on anthropology, the reviewer is Professor of Anthropology and Curator of Ethnology at the University of Pennsylvania.

THE EXPLORATION OF MARS

----- by Willy Ley
and Werner von Braun

Viking Press, \$4.95

176 pages, Illus.

EARTH'S red neighbor planet, Mars, is now nearer the earth than it has been since 1924. By writing *The Exploration*

of Mars for publication in 1956, Willy Ley and Werner von Braun have taken advantage of the current interest in this planet. They have done a fine job; the neatly documented chronological account of the history of Martian observation is particularly worth reading. The last half of the book consists of a somewhat modified repetition of the authors' earlier writings on space travel vehicles and methods, and a proposed plan for a visit to the planet. As usual, Chesley Bonestell's superb astronomical art work adds a glamorous touch.

JOSEPH MILES CHAMBERLAIN

The reviewer, Chairman of the American Museum-Hayden Planetarium, has written many popular magazine articles on astronomy.

EXPLORING AMERICAN CAVES

----- by Franklin Folsom

Crown, \$5.00

280 pp., 128 photos

NO two caves are alike, as the tourist discovers, and if this is true of "show caves" it is no less true of the "wild" caves that spelunkers find so alluring. In this book the potential spelunker will find practical advice on every aspect of caving, from footwear to headgear, from kneepads to underclothes, and on such basic essentials as lights and food. An astonishing description of the well-equipped caver is given, but it is explained that "no spelunker can face an unknown cave with all the equipment he or she needs. A corps of porters couldn't carry it all."

For those who like their caves well-lighted complete with guide ropes, an up-to-date directory of the 144 caves that are open to the public is given. There is a glossary of speleological terms, a list of the National Speleological Society's chapters ("grottoes"), a suggested reading list, and a sample data sheet for reporting newly-discovered caves and their features.

But there is much in this book for the armchair explorer. The major part is devoted to the cave findings of geologists, climbers, anthropologists, historians, and biologists.

The author, Franklin Folsom,—no relation to Folsom Man, he says—is a former Rhodes Scholar who has published in fields ranging from adventure to poetry. In this present enterprise he has channelled his interest in outdoor living into a caving campaign spread over several years and has had the active support of a team of experts from the National Speleological Society. Consequently his book reflects up-to-the-minute thinking and practice in this country.

A good index completes the book. A generous number of pictures is included,

in four sixteen-page sections, but their reproduction is unaccountably poor.

CHARLES E. MOHR

The founder and past President of the National Speleological Society, the reviewer has been exploring caves for 25 years and has written extensively on the subject.

THE SPIRIT OF THE WILD

----- by William J. Long

Doubleday, \$4.00
256 pp., illus.

SWIFT IN THE NIGHT

----- by William B. Mowery

Coward-McCann, \$3.75
254 pp., illus.

THROUGH an uncanny coincidence, the "nature faker" controversy which raged in 1907 has been revived in 1956. The Reverend Dr. Long's magazine articles which appeared in *Sports Afield* and *Sports Illustrated* have been collected by his daughter in the present book. Paul R. Cutright analyzes *Theodore Roosevelt, the Naturalist* in his book of that name.

After reading *The Spirit of the Wild* it is easy to see how Dr. Long's writings irritated so forthright a naturalist as Teddy Roosevelt. The "beauty, clarity and wisdom of Dr. Long's almost forgotten style of writing" (so described in the book's Foreword) suggest the beauty of a hedonist story, the clarity of a campfire tale, and the wisdom any clergyman might seek in nature.

There can be no doubt that Dr. Long observed animals extensively in the wild or that he was a skilled woodsman and hunter. It is evident from his stories, however, that his aim was more to tell the unusual than the usual, more to present anthropomorphic conclusions than accuracy. The dogmatic "That is why . . ." the bird or mammal acted, (as reported by Dr. Long), formed an ever-present goal; too often the particular became the sweeping generalization.

This was especially the case in Dr. Long's several attacks on conservation theory. He claimed that the principal food of the larger predators is the healthy rather than the sick and the maimed. No doubt healthy animals are taken at times, but the statistics of trained, experienced biologists do not support those who would exterminate mountain lions and other large trophies of the hunt.

Possibly the book's final two chapters ("In Quest of Animal Psychology" and "The Question of Animal Reason") were penned long before the author's death in 1952 at the age of 86. Yet to reprint them today is to tilt a Quixotic lance at a moldering windmill. For many years students of animal behavior have had a far broader

view of instinctive action than the early, narrow one Dr. Long disputes.

In *Swift in the Night* William Mowery presents foxes, wolves, groundhogs, and cottontails so skilfully and sympathetically that they emerge as individuals. After reading swiftly through this collection of tales of fields and woods — you don't want to stop from curiosity as to what happens next — the reader itches to get into the woods and fields to watch animals and admire plants afresh, preferably in the company of Mr. Mowery.

His wild birds raised in friendship from the day they were orphaned until they could fly on their own, give the same warm feeling for almost any bird, whether a foundling or not. Two chapters hold a special appeal for plantmen and gourmands — one on the superior edibility of puffballs, morels and a few other wild, free, fungus foods, the other on ingredients from the countryside which can be assembled into tasty and vitamin-rich salads.

Mr. Mowery is Director, as well as founder, of the Professional Short Story Writing School of New York University. He has been able to find time from his occupation to follow his personal inclination which is the out-of-doors. Whether he is trying to account for the modern success of groundhogs or the progressive disappearance of wolves (he makes no false accusations as to their danger to mankind), he is convincing and clearly on familiar ground.

That all of these chapters have appeared before in other magazines is not a drawback since few readers will have seen a third of them before.

LORUS J. AND MARGERY MILNE

The reviewers are Professors of Zoology at the University of New Hampshire; the authors of several books on nature (*The World of Night*, 1956), and magazine articles on animal life.

VICTORY OVER K2

----- by Ardito Desio

Translated by David Moore

McGraw-Hill, \$5.75
273 pp., photos

PEOPLE the world over were thrilled in August, 1954, by the news that K2, the second highest mountain in the world, had been climbed. In *Victory Over K2* we now have the story of that successful expedition as told by its leader, Professor Ardito Desio, Professor of Geology at the University of Milan.

The thorough planning and size of this "heavy" expedition is impressive. Far larger than the English party that climbed Mt. Everest, Desio's group had a double purpose: mountaineering and scientific research. Desio himself skillfully co-ordinated the two programs from his base camp and kept in touch with the climbing party

continued on page 389



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Their History, Geology, Lore and Location: A Spelunker's Guide

By FRANKLIN FOLSOM
CROWN PUBLISHERS, New York

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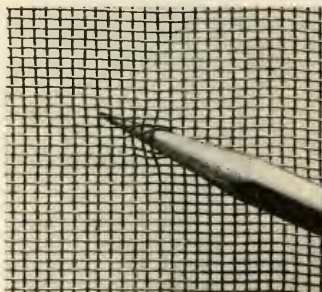
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Can you trust the **WEATHERMAN?**

He admits that he's about fifteen per cent wrong, but a new electronic computer can now perform the mathematics that will bring weather predicting closer and closer to an exact science

By WILLIAM BARRY FURLONG

THE room rumbles with a suppressed power. It is air-conditioned—75 degrees and 50 per cent relative humidity every minute throughout the year. Scattered around are eleven gun-metal gray, shoulder-high cabinets, purring and gulping eerily. Across a keyboard, tiny red lights twinkle like a miniature Broadway. Opposite it, a slot slowly disgorges a sheet of paper.

The numbers crowded on it are vaguely regular, reminiscent of the eddies of a rock-filled stream.

This is where the "701" is caged. The 701 is the electronic slave that is helping to unlock the secrets of the weather. Every day, in its second-floor cage in an office building in Suitland, Maryland, this computer digests thousands of figures, adds and multiplies them at

a speed almost beyond comprehension. It can make 16,000 additions or 2,000 multiplications every second. What it spits out is a prediction of where great masses of air will be in 36 hours. These deliberations are speedily sent to Weather Bureau and military stations all over the continent to help local weathermen forecast the weather in their area the next day.



The 701 is one of a battery of scientific tools that are making weather forecasting less of an art and more of a science. Rockets, radio, radar, high-level balloons, automatic weather stations—all these are part of the fast-developing system that is gradually squeezing the error out of our weather forecasts.

How great is that error? At present, about 15 per cent.

Why does it seem greater? Because the weatherman always seems to strike out on the big ones. "There's no trick in predicting the usual weather," one forecaster has said. "The hard thing is to predict the unusual weather."

Are the weathermen themselves satisfied with a 15 per cent error? No—but they recognize better than anybody else the difficulties of their

problem. "If at times the meteorologist makes mistakes," says Dr. Sverre Pettersen of the University of Chicago, "it's not because he's so poor but because his problem is so complex."

What is that problem? To stand at the bottom of an ocean of air which, as Dr. Pettersen says, "goes from catastrophe to catastrophe." To explore that ocean with instruments which, modern though they seem, are scarcely more advanced for their purpose than a horsecar in the jet age. To assemble data from a comparatively few points (who knows what happens in the skies over the poles or over Siberia?) and to digest and analyze that data in order to predict which kind of "catastrophe" is going to happen next and where.

If man ever learns to control weather over large areas, these "catastrophes" may provide the most powerful weapons in his horrendous arsenal. For each change in weather surges with energy that dwarfs the most awesome of atomic bombs. An average-size hurricane releases in any moment enough energy to match the instantaneous explosion of 1,000 atomic bombs. If the energy that falls from the sun on a farm one mile square in Nebraska could be stored and converted, the farmer would have a power plant the size of Hoover Dam. And a one-inch rainfall releases enough energy to match three days of sunshine. Indeed, the potential of disaster in any change of weather causes one weatherman to remark that, "Somewhere, at every minute, the weather is a serious matter."

Why Predicting is Difficult

As yet, meteorologists are struggling with more primary problems: understanding the weather and its causes enough to predict it with greater accuracy. The problem is one of the most complex known to man. "Meteorology is the only science which regularly tries to predict what is going to happen tomorrow," says Dr. Pettersen. "Most sciences only tell you what has already happened."

Long and embarrassing experience has taught forecasters for the U. S. Weather Bureau that their errors spring from three sources: mistakes in timing, in geography, and in development.

Mistakes in timing occur when the forecaster predicts the right kind of weather but is off schedule.

Mistakes in geography happen when the right weather comes but in the wrong place.

Mistakes in development occur when the forecaster simply misjudges the build-up, dissipation, acceleration, or direction of an air mass. Usually this leads to the most glaring mistakes.

On the morning after Christmas, 1947, for instance, the Weather Bureau in New York predicted that



Courtesy IBM

Electronic assistant-701

▲ GOVERNMENT WEATHER EXPERTS at the control console of the IBM 701 electronic computer at the Joint Numerical Weather Prediction Unit, Suitland, Maryland. Dr. L. F. Richardson, an outstanding British meteorologist, estimated that with the tools available in 1922 it would have taken some 64,000 mathematicians to make accurate daily forecasts. This electronic computer, as one of the weathermen humorously puts it, "does everything but hand us an umbrella when it's time to go home on a rainy evening."

Rawinsonde

INSTRUMENTS for automatically broadcasting weather conditions from unmanned high altitude balloons—known as rawinsonde—were developed during World War II.

the weather would be “cloudy today with occasional snow ending during this afternoon, followed by partial clearing.” The forecaster overlooked a snowstorm blossoming over the Atlantic off the coast of southern New England. Instead of swinging out to sea—as such storms usually do—this snowstorm swept inland and dumped most of its burden on New York City. Between 3 P.M. and 4 P.M. that day, when the snow was supposed to be ending, the storm reached its peak, unleashing 3.2 inches of snow. The storm continued through midnight, transforming New York into a white-mantled, isolated shell of a city. The staid *New York Times* reflected the stature of the storm. It ran a three-line, eight-column headline—exceptionally rare in the *Times*—to record the greatest snowstorm in New York’s history: 25.8 inches of snow in 18½ hours. The forecast, said the *Times* later, was “the understatement of the year.”

“Development is one of the most difficult things to predict every time,” says one forecaster. “You can watch the air masses move and remember what happened in the past, but you can’t be sure the same thing will happen again.” An error of only five miles per hour in the estimate of a hurricane’s speed in moving up the coast will throw a forecast 120 miles off in one day. An error of a single degree in its direction at Cape Hatteras may find the weatherman far wrong by the time it hits the latitude of New England. “And remember,” says the forecaster, “that a hurricane—or any air mass—can change its speed and direction half a dozen times within a couple of hours—after you’ve made your prediction.”

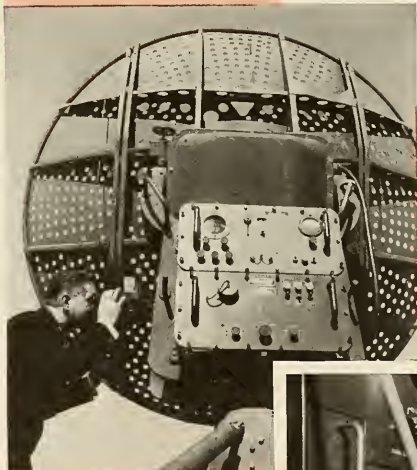
Not only must the forecaster accept the whims of the weather but also the public’s. “We find,”

CAN YOU TRUST THE WEATHERMAN?



◀ HERE we see such a mechanism being launched. In the weatherman’s hand is the radio transmitter and instrument box. Farther up the cable is the parachute that will carry the instrument box safely to earth. Above is the balloon.

➤ A RAWINSONDE instrument box and radio transmitter. This is the “nerve center” and “voice” of modern, three-dimensional weather study.



◀ THIS is the tracking antenna that follows the rawinsonde balloon and listens to its messages. The observer is aiming it by means of a telescope.

➤ RAWINSONDE OBSERVATIONS are plotted directly on graph paper and must be evaluated to obtain useful information.



says one employee of the Weather Bureau, "that many persons can't remember accurately what the weather was yesterday." The personal equation is strong in impressions of the weather. The farmer in the Middle West is much more sensitive to changes in the weather than the broker in the canyons of Wall Street. The teen-ager at the beach is more aware of a passing cloud than the stenographer in an air-conditioned office. The housewife in the suburbs is more conscious of the approach of rain than a factory worker. In winter, a warm spell always seems unusually warm. In summer, the first hot spell seems unusually uncomfortable, because we haven't yet adjusted ourselves.

Taking the Job Seriously

Forecasters are sensitive. "I've known some meteorologists to go without sleep at night if they 'blow' two or three forecasts in a row," says one Weather Bureau man. "And sometimes, the atmosphere is so confused that a forecaster just feels like going home and forgetting about the whole thing."

However, the occasional fumbles of the weatherman rarely weaken his popularity in commercial circles. Some 2,600 subscribers consider the Weather Bureau's 30-day outlooks worth the \$4.80 a year they cost. The daily forecasts are crucial to uncounted thousands in scores of fields. Cattle ranchers, fruit growers, outdoor theater operators, sellers of umbrellas all demand to know what the weather will be tomorrow, and the day after tomorrow, and day after day after that. An advertising agency wants to know when it should plaster billboards with ads for tire chains. A Los Angeles publisher slips his newspaper into wax wrappers on rainy days. A leather company wants to know how much the sun will shine because its patent leather is dried in the sunshine.

In the Gulf of Mexico, oil companies want to know the height of the waves they can expect to smash against the rigs drilling beneath the

Many factors influence prediction

▼ WEATHER PREDICTING involves rapid translation of complex data to maps. These experts at the Weather Bureau-Army-Navy Analysis Center in Washington are analyzing a weather pattern.



sea's surface. In Hollywood, a motion picture company wants to know when a certain cloud will appear on the horizon, how much sun will shine tomorrow, or when they can expect a beautiful sunrise. In Chicago, a department store wants to know how windy it will be (women won't buy hats on windy days) or what time of day rain may be expected (early morning rains keep the shoppers at home, afternoon rains trap them in the store). In Baltimore, a bakery notes that sweet goods sell better in cool weather than hot, and that

wet weather makes neighborhood sales fall off and downtown sales spurt sharply upward, because when it rains, housewives call their husbands to buy the cake on the way home.

In 1945, a long, freezing rain deluged much of Iowa, delaying the planting of corn. As the summer wore on, the farmers realized that a great deal more sunshine was needed for the crop. But if they left the corn in the fields, they would take a multimillion-dollar risk of losing the whole crop to a sudden frost.



▲ **CLOUD CEILING**, of vital importance to airplane pilots, is determined by this rotating beam ceilometer. Its light beam hits the cloud base and is picked up about 1000 feet away by a photoelectric scanner. The altitude is then calculated by trigonometry.

▼ **HERE A WEATHERMAN** at the Washington National Airport is observing the beam of the rotating ceilometer by radar scope.



▲ **FOR MEASURING** how hot the sun is. The so-called normal incidence pyrheliometer records the intensity of the direct rays of the sun.



▲ **WIND VELOCITIES** are recorded by the well-known anemometer, which can be seen rotating atop most weather stations.

▼ **AN EVAPORATION TANK** at the weather station at Silver Hills, Maryland, and a three cup anemometer.



They brought their problem to Jerome Namias of the U.S. Weather Bureau, who promised to give them at least a week's warning before the arrival of the season's first frost. As summer passed into autumn and the tang of the air grew sharper, no word came from Namias. The corn grew higher and yellower and thicker; still no word from Namias. The worried farmers debated taking in the crop without a warning but decided that it needed still more sunshine and elected to trust Namias. Nerves were on edge when word came from him. "Take in the

corn!" They did—before the frost struck—and gathered a handsome crop, rich and yellow from its long basking.

Even presidents have placed a unique trust in the weatherman. In February, 1950, when the nation was threatened by a strike of coal miners, President Harry Truman weighed the prudence of declaring a national emergency. "If the weather is going to stay warm," he reasoned, "we'll have enough coal above ground to get by. But if it's going to turn cold, I'll have to declare a national emergency." The

White House summoned Namias, who studied his data and warned the President that a cold snap was due within a month. Shortly thereafter, President Truman declared the national emergency.

Ever since the beginnings of recorded history, man has gazed speculatively, even fearfully, at the sky and pondered its secrets. The Greeks of the ancient world, the American Indians, and many primitive peoples believed that their gods resided in the sky and that the weather was a portent of their moods. Angry French grape grow-

ers once tried to halt a damaging hailstorm by firing cannonballs into the sky. The roster of battles decided by the turn of the weather reads like a roll call of history's great struggles—Napoleon and Hitler before Moscow, the British at Gallipoli, the Allies at the Battle of the Bulge. Indeed, it was a heavy rain that bogged down Napoleon's light artillery and delayed him enough to cause his defeat at Waterloo.

War gave meteorology its great impetus. World War I brought the important theory of moving air masses, developed by Scandinavian meteorologists; World War II developed technical discoveries such as radar, rockets, and rawinsonde balloons for automatic broadcasting of conditions at high altitudes. But once war ends, the urgency—and the appropriations given to meteorology—dwindle. This year, 19.3 cents will be spent for every American. This is a decided increase over what has been spent in other post-war years, but as one nongovernment meteorologist puts it, "There isn't much you can buy for 19 cents a year."

It is not money alone but a gnawing sense of dedication that drives men to probe the secrets of the weather. Observers have been left for months on floating islands in the Arctic Ocean to study weather phenomena. Others have plunged in planes through the turbulent skirts of a hurricane and entered its very eye in search of its secrets. Almost 10,000 unpaid volunteers note temperature and precipitation in their counties every day for the Weather Bureau—and some of them have been doing it daily for 65 years.

Manpower is now sturdily augmented by science. All across the nation drift huge helium-filled balloons, tracing the pattern of winds high in the atmosphere or radioing data down. Through radar, the depth as well as the width of storms can now be measured. In some inaccessible areas, automatic weather stations are mounted to

It's still up to the Weather Man

➤ GATHERING THE FACTS is one operation; plotting and interpreting them is a complex task involving judgment based on experience and a knowledge of advanced mathematical techniques. Great strides in instrumentation are enabling the Weather Bureau to set new goals in speed and accuracy of prediction.

record everything that a human weatherman might note. (Once a military pilot, circling an abandoned robot weather station on a Pacific island, reported that it was being worshipped as a shrine by the natives.)

Altogether, some 375,000 observations pour into the National Weather Analysis Center near Washington every day. They come from all over the Northern Hemisphere, including at least 300 stations in Russia but none in Communist China. In the U. S., the weather stations exchange information as regularly as if the atmosphere were a market place. With this information, each forecaster constructs his local prediction. Usually he employs a combination of three methods—experience, statistics, and a comparatively new technique called numerical prediction.

Old Methods and New

Experience is an important factor in forecasting. The weatherman studies the charts showing the movement of air masses in his area and any that may be approaching, and compares them with any similar patterns he may know from past experience. He then makes a prediction, taking into account whatever variations are noted in the current situation, for no two occurrences are exactly alike. This method of prediction is called "subjective forecasting."

One of the drawbacks of "subjective forecasting" is that it relies greatly upon the memory of a single individual. "A man with a prodigious memory can do quite well," says Dr. Pettersen. But when such a man dies, there is no way for him to pass his experience on to his successor. Some years ago, an attempt was made to overcome this, as well as to introduce more sci-

ence and less art into forecasting. Air mass movements were charted for selected areas for every day in the last half century or so. The forecaster desiring to analyze conditions on any day then had only to refer to these charts, or analogues, to find a similar pattern in the past and thus make a similar forecast. On November 24, 1951, for instance, a 22-inch snowstorm struck Cleveland and vicinity—exactly as predicted. One forecaster later explained that, "The weather map for November 8, 1913, could have been used as the weather map for November 24, 1951—and a 22.2-inch snowstorm hit Cleveland on that earlier date."

Two statistical methods are being explored for use in forecasting. The first is for local use only. A weatherman selects certain conditions in the atmosphere, then probes the past to see what happened when the same combination of conditions existed. If it snowed in 75 per cent of the cases, then he predicts a 75 per cent chance of snow. If the snow reached 2 inches on 30 per cent of the occasions, he then anticipates a 30 per cent chance for a 2-inch snowfall.

But broader investigations into the use of statistical patterns for long-range and large-area forecasts are underway. "Anything that happens in a pattern," as Dr. Pettersen puts it, "is susceptible to study through statistics." However, application of the statistical methods in meteorology is extremely complex and is still under study. The data must be assembled into patterns before it can be used for prediction. This calls for a detailed analysis of weather phenomena over long periods.

The numerical prediction method is based on a set of equations which describe, mathematically, the mo-



USWB

tion of the atmosphere. The physical basis for the equations was suggested in 1939 by Dr. Carl-Gustaf Rossby after earlier explorations in the field had had only partial success. Dr. Rossby was particularly interested in the movement of air masses at high altitudes and in learning how they influence weather at the earth's surface. With World War II came the devices—rockets, high-altitude balloons carrying radios and recorders, etc.—which could penetrate the upper atmosphere to make the vital observations.

At about the same time, a special task force at the Institute for Advanced Study was adapting Dr. Rossby's equations for use in an electronic computer—and then designing the computer that could solve the equations. The task took six years. As it eventually evolved, the technique demanded that observations of the atmosphere be made at numerous points and translated for use on a huge grid map of the United States and parts of the flanking oceans. These observations, made for a theoretical

instant in time, were then worked into the equations which could be solved by the electronic computer. The whole system is called "numerical prediction."

The Numerical Prediction Unit was set up in the middle of 1954 at Suitland, Maryland, by the Weather Bureau, the Air Force, and the Navy, but it did not receive its electronic computer until April, 1955. The 701, an amiable if not affectionate slave, is rented from International Business Machines for \$20,000 a month—and is regarded as cheap at the price. "We're moving so fast in this field," says Dr. George Cressman, Director of the Joint Numerical Weather Prediction Unit, "that our present computer can be considered to be in the Model-T stage. We understand that there are on the drawing boards computers that can work ten times as fast."

Every morning at six o'clock, the computer is turned on and given two and a half hours of warm-up and checking by IBM maintenance men. At 8:30 A.M., it is turned over to the Numerical Prediction

Unit. Until noon, research projects are pushed through the machine. "It took us four man-years to work out the code for one set of instructions to the machine," says Cressman. Another two man-years will be consumed on any one of several other projects.


By late morning, observations are pouring into the National Weather Analysis Center, which relays the desired data to the Numerical Prediction Unit. The computer is set to work on a simple preliminary prognosis on weather conditions at 16,000 to 20,000 feet for as much as three days in advance. This consumes about a half hour.

Meanwhile, information from various weather stations all over the United States is being assembled and coded on punched cards. This data must be interpolated for the 551 grid points on the maps used by the Numerical Prediction Unit. "Unfortunately, the weather stations are seldom at the intersections of our grid points," says Cressman, "and we must take the data reported by several stations surrounding a grid point and interpolate it for the grid point." Originally, this task was done by hand and took almost five hours. Now the computer makes the interpolations and memorizes them. In one set of memory cells, the 701 can store 4,000 five-digit numbers; in another, 16,000. And on four tapes used to augment the memory cells, it can store some 400,000 five-digit numbers.

While the machine is doing this, the punch-card crew is drilling out a set of instruction cards. About 4:15 P.M., with the interpolations stored in the machine, the instruction cards are inserted. Then the computer gets down to the task of grinding out a prognosis of the movement of air masses at three levels—roughly 3,000 feet, 10,000, and 23,000 feet—for the next 36 hours.

The prognosis is made with a beguiling coyness. It is not made in a single leap but in a series of small, relentless steps. With the conditions reported that morning,

continued on page 38



By
RALPH N. HILL

Victory over the SHARK

ON December 7, 1941, the assault on Pearl Harbor obscured a tragic scene in the South Atlantic. A light British cruiser had been torpedoed. Seaman Albert E. Partou, a survivor, reported that as he crawled aboard a life raft he saw fins cutting the bloody water about him, and swimmers being pulled grotesquely under the waves. Awash on heavily laden rafts, the survivors spent five days beating off sharks with paddles. Of the cruiser's complement of 450 men, only 170 escaped the torpedoing and the frightful attack of the sharks.

Although the extent to which sharks are dangerous to human beings is controversial, authorities at least agree that some kinds of sharks will attack under certain conditions. There are recorded instances where sharks have struck men singly or in pairs. On one occasion, when a plane carrying three fliers sank off the South American coast, the sharks, after a leisurely investigation, seized one of the

fliers. An hour passed before they struck a second. The third swimmer succeeded in reaching the shore.

A government report of this depressing event came to the attention of Dr. Harold J. Coolidge, of Harvard University, who was currently working in Washington for the Coordinator of Information. Discussing the shark menace with his associates at Harvard's Museum of Comparative Zoology, he conceived of the possibility of a chemical that would repel sharks. Both he and his friend, Dr. Henry Field, at that time at work on a special assignment for the White House, were aware that fear of sharks was a morale problem among survivors of ships sinking in the Caribbean and the Pacific, as well as among fliers. It seemed unfortunate that this worry had to be added to the strains of war. If merely the smallest fraction of the directed effort that had produced new super-weapons were to be focused upon the nature and habits of the shark, perhaps some defense might be

found. Surely, they reasoned, an attempt would be worthwhile.

Thus began one of the strangest scientific projects of the war. It was initiated by Coolidge, recommended by the medical division of the National Research Council, and undertaken by the Office of Scientific Research and Development through a contract with the Marine Studios in Florida. Interested parties were the Navy, the War Shipping Administration, and the Air Force.

W. Douglas Burden, president of the Marine Studios, a giant new aquarium of ocean life, was intrigued with this problem, but not too hopeful that it could be solved. Assuming that a shark repellent could be found, he asked the War Shipping Administration what percentage of effectiveness they would be satisfied with. They replied that morale was their chief problem and that they would be pleased to have some sort of repellent to give their crews, even if it were only 50 per cent effective. Later they reported



How courage and persistence removed an ancient menace of the sea. The story of one of the strangest projects of World War II

that they hoped this figure might be raised to 66 per cent. They continued to impress upon Burden the importance of producing at least something. While they knew that attacks by sharks were rare, the news of a single such incident had a way of becoming general knowledge among crews.

As the war had forced the closing of the Marine Studios in Florida, research started at the Woods Hole Oceanographic Institution in Massachusetts. Burden's problem was to find a substance sharks would not attack, analyze it, and extract from it the offensive chemical ingredients. If this could be done, it was presumably possible to combine these ingredients in a concentrated substance which, when released in the water by a sailor or airman, would act as a repellent. Staff members of the American Museum of Natural History in New York, of which Burden is a trustee, searched the reference books for data on the subject, but found nothing significant. Even ethnological literature dealing with the natives of islands in shark-infested waters proved barren of helpful facts or folklore. Obviously then, the quest for a shark repellent would involve the most basic research.

The first step was to tempt three-foot dog sharks, recently placed in the Woods Hole laboratory tanks, with various kinds of poisoned meat. The experiments were at first discouraging. Showing little discrimination, the sharks readily seized meat containing the strongest poisons. It was immaterial that they died within half an hour after eating—the point was they had swallowed the bait. Ultrasonics failed to dull their appetite. Different kinds of ink clouds failed for the reason that the shark in seeking

food relies on his sense of smell, more than on sight. Even so, war gases did not deter them, nor did a variety of stench and irritants.

At last it occurred to Stewart Springer, senior scientist on the job, to try decomposing shark meat as a bait. Florida shark fishermen had reported that whenever storms kept them from picking up sharks that had died on their hooks, no other sharks were to be found within a wide radius. This observation led the scientists to an exciting discovery. Decomposed shark flesh from four to six days old proved so distasteful to the Woods Hole dog sharks that a series of seventy-five tests was conducted on this bait alone. Pursuing the unknown repellent factor in it, the research staff journeyed to the shark fisheries in Salerno, Florida. There sharks were allowed to decompose in vats. The liquid was evaporated off slowly until all that remained was the evil-smelling residue. Samples of this were sent for analysis to Dr. David Todd, a chemist, who after some months determined that the "X" factor was ammonium acetate.

Still further research revealed that the repellent agent was acetic acid, given off when ammonium acetate is dissolved in water. Meanwhile Arthur McBride, formerly of the American Museum of Natural History and later curator of the Marineland Biological Laboratory, found that copper sulphate was an even more powerful repellent than the extract from decomposing shark meat. Maleic acid proved to be a deterrent also, but a less effective one.

So promising were the results obtained with the shark meat extract and with copper sulphate that the experiments were moved out of the laboratory into the open sea.

Only there, under natural conditions, could the Woods Hole tests be verified.

The search for sharks began off the coast of northern Florida between Jacksonville and St. Augustine. This effort proved fruitless, as did an expedition to the Florida Keys, so the Navy and Coast Guard dispatched subchasers to help the scientists in their continuing search in the waters around Cuba. Havana harbor was supposed to be a likely place, but the efforts of a Navy lieutenant commander, together with a dozen native fishermen, failed to find sharks in anything like the numbers necessary to test the repellent. Ernest Hemingway, suggested some locations, but these too failed to produce any sharks.

The scientists well knew that the shark is a vagabond, ranging widely in his quest for food, but they had not expected such difficulty in this direction! It was most frustrating. They decided to go further south—to continue looking off the coasts of Ecuador and Peru at the edge of the Humboldt current. On December 1, 1942, this telegram arrived in the American Embassy at Quito, Ecuador:

The Office of Scientific Research and Development of the Office for Emergency Management has entered into contract with Marine Studios for an investigation of possible means of protection of men adrift in life belts against sharks. . . . It is proposed to send an expedition consisting of Mr. Arthur McBride and Mr. Arthur Schmidt, both of the American Museum of Natural History in New York, and Mr. Charles Breder, Director of the New York Aquarium, by plane as soon as possible to conduct these experiments. . . . You are requested to secure permission from the Ecuadorian government for the . . . necessary investigation in the territorial waters of Ecuador. . . . You are also authorized to transmit reports from the investi-



◀ ARTHUR SCHMIDT, Charles Breder, and Arthur McBride at their camp on La Plata Island off Ecuador.

▼ THE "FLOATING LABORATORY" aboard the *Willpet*, showing supply of various repellents being tested.



▲ A SCENE from the film, *The Sharkfighters*, illustrating the efforts of the Navy to locate sharks off the coast of Cuba.

gators via diplomatic pouch. Please take up this matter on an urgent basis and report by telegraph.

CORDELL HULL

The expedition began on December 6, 1942, almost a year to the day after the human feast of the South Atlantic sharks following the sinking of the British cruiser. The shark population off the coast of Ecuador was reported second only to that of Australia. As their cabin cruiser, the *Willpet*, neared the island of La Plata, 25 miles off the Ecuador coast, the scientists were hopeful. The waters around the island are the site of vast migrations of shrimp

followed by feeder fish. It was logical, therefore, to expect sharks in large numbers.

Two years previously a porpoise-hunting expedition to La Plata had failed because the moment the fishermen got a porpoise on the line, the water fairly boiled with hammerhead sharks. In a twinkling, only a patch of bloody water was left where the porpoise had been. Now, however, the scientists for some reason could not attract sharks in any quantity. They baited their hooks with wahoo, bonito, massive jacks, and tuna, as well as with freshly killed goats. They trolled,

drifted with surface baits, anchored and still-fished by day and by night, yet the sharks completely ignored their bait.

The *Willpet* then returned to Salinas, as the natives there reported that the dumping of garbage into the sea had attracted sharks in large numbers. The fishermen now tried drifting their baits—sides of beef, whole goats, and fresh fish—near the coast and as far as five miles offshore from the garbage dump. These efforts did not produce sharks either, nor did an expedition up the coast to Pelado Island. At length, the scientists decided to return to La Plata. This time they hired some fishermen to accompany them and to collect bait so that they might fish more intensively. But their efforts were in vain. Apparently the sharks were just not present in anything like the numbers necessary for their experiments!

The *Willpet* then headed for the town of Posorja, which clings to the rim of mangrove-bordered lagoons where the Quayaquil River flows into its gulf. Broad, shallow, and admirably sheltered from the swells

of the ocean, the lagoons teem with mullet, snappers, the common jack and amberjack—all good hunting for sharks.

Mullet were particularly plentiful at the mouth of a small tidal estuary called the Rio Morrow, which they entered with each rising tide. Directly behind them, chasing them along the surface, came great numbers of black-tipped ground sharks.

McBride and Schmidt broke out their gear with all the trembling excitement of fly-fishermen surrounded by rising trout. "We had everything," wrote McBride, "abundant sharks following a set routine, abundant bait, and a calm anchorage right in the experimental grounds permitting work 24 hours a day . . ." Three lines were set out, an experimental one containing the repellent, and two without it to act

as controls. Shark hooks, hung from balsa floats to a depth of eighteen to twenty-four feet and baited with mullet, were allowed to drift astern as the *Willpet* came to anchor. Eighteen-foot bamboo outriggers kept the three baits nearly forty feet apart so that the repellent, tied above the bait on one line, had no effect on the other two. At the same time, all three lines were set well within the shark channel since it was vital that they form equally convenient targets.

Crescent-shaped calling cards

The results were spectacular. The baits scarcely settled down under their cork floats before they were taken. The clothespins holding the outboard lines to the outriggers let go and the deck of the *Willpet* was thrown into feverish activity. The pulling and hauling necessary to

land the ordinary run of deep sea fish leaves the sportsman completely spent at the day's end. Here the quarry was often much heavier and less manageable. No sooner was a shark brought in and released from the hook, the line rebaited and reset, and the character of the strike recorded, than the cork float on another line would disappear and the combat would be renewed. This, of course, was just what the scientists wanted—the more strikes they could tabulate, the better. At every rising tide, day and night for sixteen days, the busy crew of the *Willpet* toiled here to take advantage of their good luck.

While the sharks often succeeded in cutting the bait just short of the hook, they invariably left their calling card in the form of a crescent-shaped imprint, so that the scientists were able to record the strike

▼ A SHARK about to gulp its meal at Marine Studios, Florida, where the first experiments were conducted.



as that of a shark, even though they did not know what kind. Most of those caught were the powerful and very fast black-tipped ground sharks which often cleared the water like sailfish as they tried to throw the hook. A larger species of ground shark, *Carcharhinus azureus*, measuring nearly eight feet, was brought in also, as were small hammerheads.

Besides coping with their restless lines, the scientists had to attend to several other things. Each repellent had to be weighed with a spring balance. Then the repellent was put into a diffusing bag attached to the experimental line above the bait. Copper sulphate proved very soluble and had to be enclosed in a bag composed of several thicknesses of tightly woven cloth. Copper acetate diffused less rapidly and required a different kind of bag. After each experiment, the bag was removed from the line and the remaining chemical was dried and weighed to determine how much had diffused in a given length of time. For how else could the scientists find out how much or how little was necessary to repel a shark?

Copper acetate the answer

Before many days the statistics could be arranged in exciting patterns. Copper acetate—the double-barreled repellent extracted in Massachusetts—was producing almost magical results! As soon as it began to diffuse at the rate of as little as one-tenth of a pound an hour, all strikes would cease on the experimental line.

Hung near the bottom where the sharks enjoyed feeding, even the choicest bait remained untouched when the repellent was at work. Quickly and unexpectedly, the South American expedition had become a success!

Soon after McBride and Schmidt returned to the United States, a meeting was called in Washington for the purpose of informing some twenty authorities of the progress in this peculiar war against sharks. In presenting his report, Chairman Burden claimed that copper acetate

had a nearly perfect record of repellence, a statement which he supported with the convincing data supplied by McBride. He was careful to say, however, that he did not know what effectiveness the copper acetate would have under "mob conditions" — when sharks gathered in large numbers and attacked indiscriminately.

"Let us assume," said Burden, "that a lot of blood has gotten in the water prior to the introduction of the repellent material. Let us assume further that voracious sharks are present in large numbers.

"Under such circumstances sharks have frequently been seen biting at oars and boats, with such savage determination that they completely ignored heavy blows. This would seem to indicate that at some point in the characteristic shark-feeding program, the olfactory sense no longer plays a dominant role and is superseded by a mob-impulse in which visual and auditory senses both have probably played a part. This mob-impulse might be likened to the stampede behavior in animals. Under these conditions it is very doubtful if any chemical repellent would inhibit their feeding behavior thoroughly.

"However, we do believe that if acetate is sprayed onto the water from the deck of a boat before wounded men jump in, it will give protection. The point is, that the sense of smell initiates the subsequent feeding pattern, so that if this behavior can be arrested at the outset through a repellent, the more violent aspects of it could not come into being."

Success seemed so certain that the Navy took over the research program. Carrying forward the experimentation with copper acetate, the Naval Research Laboratory, together with the Calco Chemical Corporation, produced a mixture composed of one part copper acetate to four parts negrosine-type dye. This was calculated to mask the scent of the swimmer and diffuse around him an inky cloud hiding him from view. The research staff of the Marine Studios reported

that the nearest parallel to mob conditions followed the dumping of "trash" fish from the shrimp boats off St. Augustine, Florida, so the new extract was tried out there.

Attracted by shovelfuls of fish, the sharks appeared from every direction. As they slashed and cut at the bait, a movie camera on deck recorded the maelstrom. After thirty seconds of dumping plain fish, the crew shoveled in fish mixed with repellent for thirty seconds. The sharks remained to feed on these for only five seconds, then faded away completely. Thirty minutes later, when plain fish were again dumped in, a few came back. But when these were followed by fish with repellent, there was not another strike. On a third trial, the sharks would not approach within twenty yards of the boat even to attack plain fish.

This evidence was so conclusive that it convinced even the most grudging skeptics. The repellent was quickly made up into cakes, which were ordered by the services in tremendous quantities. The Air Force used it for all over-water flights between latitudes 45 degrees North and South. Sealed in a blue envelope, suspended on the end of a ribbon and cemented to the life preserver, a packet gave positive protection from sharks for from three to four hours.

American fliers had not carried the repellent long before the Australians began to make inquiries. They were skeptical, saying in effect: "The repellent may work on your sharks over there, but our sharks are known to be far more treacherous." Samples of the repellent were shipped and arrangements immediately made for experiments in Shark Bay, West Australia. It was found that the effectiveness of the repellent in Australian waters was 95.2%!

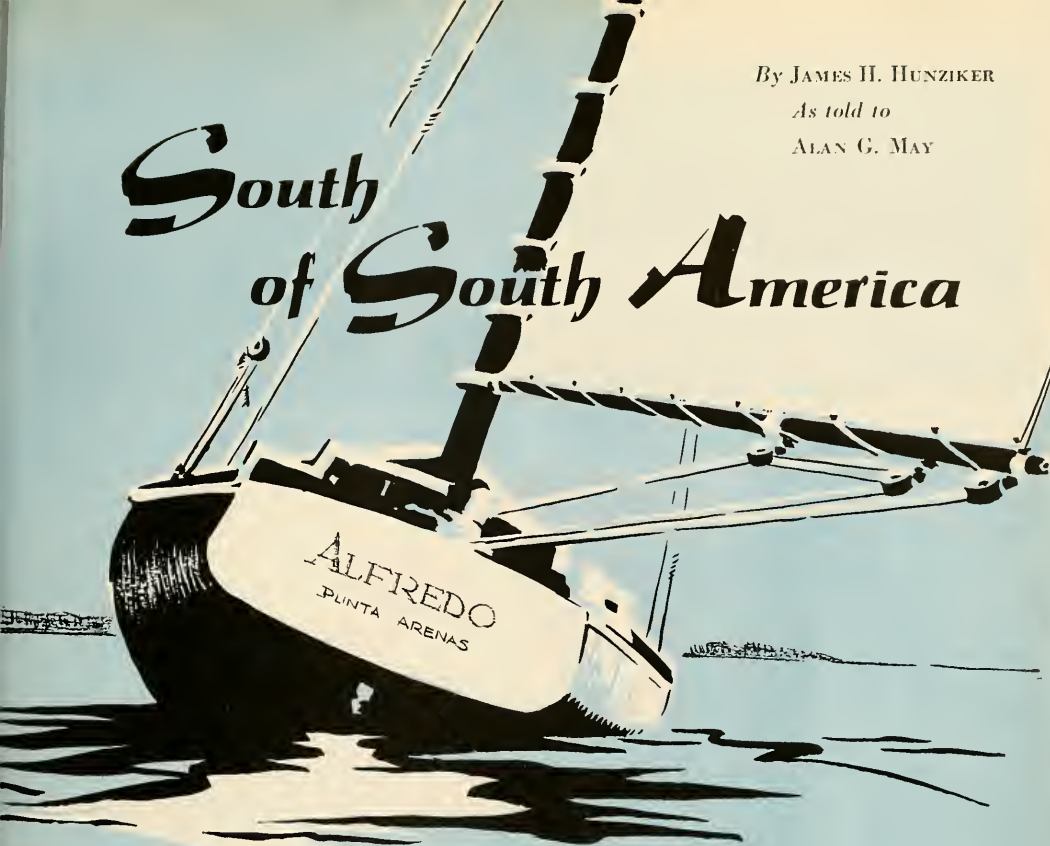
Thus by the end of World War II, one hazard of warfare, not of man's contriving had been largely eliminated. But more important still, is the reassurance given to peacetime sailors plying dangerous waters.

By JAMES H. HUNZIKER

As told to

ALAN G. MAY

South of South America



By engineless sloop to stake out a life in one of the most inhospitable spots on earth—the adventures of two sheep pioneers at a remote outpost

YOU will not find Bayly Island in the atlas or gazetteer, for it is unimportant in size. It was important, however, to my brother and me, for the island belonged to us 50 years ago, and we lived there more than two years. We were the world's most southerly residents—6500 miles south of New York and only 1200 from the antarctic icecap. Looking south from our place on Bayly, we could see Cape Horn in the distance.

Living on Bayly was no publicity stunt on our part; it was the fulfillment of a long thought-out plan. It was a serious undertaking by two young men who hoped to develop a successful sheep ranch. We needed good but inexpensive grassland and had heard favorable re-

ports of the Fuegian archipelago.

Our knowledge of sheep had been acquired from childhood, for we were born in the Falkland Islands, east of the Straits of Magellan. As a young lad I went to Patagonia and worked on my uncle's stock farm, or *estancia*, on the Gallegos River about 100 miles north of the Straits. George had also left home at the same time and worked on an *estancia* in Tierra del Fuego.

We met in Punta Arenas, eager to prepare for our new venture. Punta Arenas at that time was a small city of less than 10,000 people and proudly claimed the title of the southernmost city in the world.

While trying to decide which of

the many Chilean officials to approach, we met an acquaintance named Grandi. He told us he had started a small *estancia* on Bertram Island and could show us how to obtain rights. Before the day was over, we had been granted two of the Wollaston islands, Bayly and Grevy. They were given to us for 20 years, with the privilege of retaining them after that time if we so wished. We were dumbfounded but elated. Free property without taxes! Grandi, too, was pleased, for he would now have neighbors only 40 miles away.

Our first day of searching for a seaworthy ship dashed our spirits, for we could only find a broken-down old cutter. A seaman told us that she had capsized once and that



AMNH

▲ PUNTA ARENAS, where the *Alfredo* was bought.

no one but a half-wit would consider buying her. But she proved to be the only ship available.

She was in terrible condition, but we thought perhaps we could make her seaworthy. Far into the night we debated whether to take a chance. The next day, after hours of haggling, we bought the cutter *Alfredo* for approximately \$500.

Although the *Alfredo* was called a cutter in Punta Arenas, she was what we term a sloop, with mainsail, staysail, and jib but no engine. Her over-all length was 40 feet. She had a twelve-foot beam and drew five feet of water. For the next five or six weeks we worked from daylight till dark. There was really no hurry, but we were anxious to be on our way. We shortened the mast, cut down the sails, rerigged, caulked and painted her, and poured two feet of cement in the hold for ballast. When we were through, we received many compliments on our work. Not counting our labor, we had spent another \$150 working over the *Alfredo*.

Owing to shortage of funds, we held our staple supplies down to a minimum. Two shotguns, a rifle, and a revolver, with ammunition, would enable us to live off the island. Some tools and nails, a couple of mattresses, a cook stove, and some corrugated metal for the roof about completed our stores. The former owner of the *Alfredo* said we could dismantle a shack he



claimed to own on Admiralty Sound, which would give us our windows and some roofing.

Looking back now, I am amazed at how calmly we set out through some of the most treacherous waters in the world. Our knowledge of navigation was not profound. I knew how to navigate by dead reckoning, but that was all. We had had considerable experience in handling small boats in the Falklands. Lacking an engine, vigilance would be essential. Today, no one would think of starting out on such a venture without a good engine.

Many of the small crowd who watched us depart thought we would never return, but this fazed us not one bit. Heading south along Magellan Strait, we stopped the first night before dark in a sheltered bay. This gave us an opportunity to shoot a goose for supper. We always made it a practice if possible to anchor before dark, for we did not want to take unnecessary chances. Passing the southwest point of Useless Bay, we came across a magnificent glacier that must have been almost a mile wide where it met the water. We were headed for Admiralty Sound

and the abandoned shack. This was a long distance out of our way, but now there was no hurry, for our great adventure had begun.

A little over halfway up the Sound, we found the shack and made a gruesome discovery. Outside lay the skeleton of a man who had died sitting on the ground leaning against the wall. There was nothing to indicate foul play, so we assumed he had died of starvation. The ribs had fallen in a heap on the hip bones, and the skull lay between the legs.

Loading the windows and sheet-metal roofing aboard the next morning, we decided to go on to see if Lake Fagnano near the head of the Sound had possibilities for sheep. We walked about six miles up a small river and came to the lake. It was a beautiful place with the mountains coming down close to the water, but it was not sheep country.

We sailed down Admiralty Sound, past the large island of Dawson and out through Cockburn Channel, taking things slow and easy. The *Alfredo* handled beautifully, and we realized what a wonderful buy we had made. When we reached Londonderry

Island, we ran into bad weather and were held up for a week. However, we enjoyed hunting, exploring, and prospecting for gold. Incidentally, the gold for which we often searched was never found.

When the weather improved, we raced along in the open Pacific for about 80 miles before turning east and heading for the southwest arm of Beagle Channel. On a slack tide we ran Murray Narrows, a most spectacular pass between tall rock cliffs, and anchored off the west side of Navarin Island.

Victims of the Yahgans

While exploring here, we came across a group of seven graves. Later we learned these were the graves of the second group of missionaries to attempt to settle in the Fuegian archipelago. These good people had been clubbed to death by the Yahgans while they were holding their first divine service in a newly erected building. The first missionaries had starved to death. The third attempt, lead by Thomas Bridges, finally established a successful mission at Ushuaia.

We found that our Bayly Island covered approximately fifteen square miles. Grevy, the next island

to the north, was somewhat larger. These are two of the Wollaston group, which is composed of eight major islands and many smaller ones. Bayly appealed to us more than Grevy, so we decided to establish ourselves there, planning to expand to Grevy later if the sheep thrived.

The location we chose for our cabin was near a small bay that would give the *Alfredo* good protection from the southwest gales. When leveling the ground, we discovered we had chosen an old Indian campsite, a small shell mound in which we unearthed several bone harpoon points. Later we learned that the Yahgans called this place Ushalameut. This was to be our home.

We had brought no lumber to build the cabin, but there was no lack of material, for the wreckage of ships was piled up from one to five feet high in places. Hinges, latches, and other hardware could be detached as needed. Imagine: we built the tables, chairs, bunks, and cupboards from teakwood! Our water supply came from a small stream that ran alongside the cabin, and George found a barrel for rain water.

▼ BEAGLE CHANNEL, near the southernmost tip of South America.

AMNH photo by Beck



With our staple foods and an abundance of game, we were well fixed. We could have geese, ducks, and eggs for a minimum of effort. We caught crabs in the bay, and cod, herring, and sardines were plentiful. We could always get salmon cod, a blue-backed, yellow-bellied fish, near the kelp beds. By sailing to Navarin we could vary our diet by shooting the larger relative of the llama known as the guanaco. They were a different variety from those found in Patagonia, bigger and much tastier. Navarin is the only island south of Tierra del Fuego on which guanacos are found. Foxes, too, inhabited Navarin but not the other islands. We ate the eggs of geese, ducks, snipe, gulls, and penguins. Once we tried fried penguin but found it nauseating. We often saw porpoises but did not use them for food. Neither did we try the occasional whales that were washed ashore. One time in Beagle Channel we saw 40 whales at one time and narrowly escaped trouble when one came up to blow only a couple of feet from the *Alfredo*.

Berries grew in profusion. Wild strawberries, also called rainberries, grew close to the ground, almost hidden by the moss. Wild black currants made excellent tea, although it had a laxative effect. The *chowrie* or *goosh*, somewhat like a barberry, tasted good either fresh or cooked. Dark red *diddy-dees* could be picked by the handful. We used swampberries to make *melvina* tea, a drink often used in the Falklands. Water cress and wild celery were easy to find, and there was another plant I recognized from boyhood days as a cure for upset stomach.

After the cabin was finished, we made preparations for the sheep,

building enclosures, pens for lambing, and a rail fence across the island to prevent the sheep from straying into the woods and hills, which covered about a fifth of our island. All this from material salvaged from the beaches.

Getting the Sheep

Our hopes for obtaining sheep centered on Ushuaia, the most southerly town in the world, the capital of Argentine Tierra del Fuego. We had been out of contact with civilization seven weeks when we made the seventy-mile trip there, taking two days. Purchasing the sheep was comparatively easy, but it was another matter to persuade the captain of a small coastal steamer to take them to Bayly. It took two bottles of gin and more money than we could afford to get him to make the trip.

After the sheep had become settled, we had time to do some exploring. A large four-master German ship had been wrecked on our southwest shore shortly before our arrival. Grandi had told us a good lifeboat had been left high and dry on the rocks. As we could use this boat, we set off to find it. Going overland, we came to a place where small trees about 25 feet tall had been bent over by the force of the continual winds until they grew parallel to the ground about five

feet high. As the branches and undergrowth were too thick to penetrate beneath, we had to walk over these trees. Sliding down a steep cliff, we came to the wreck. All that remained was a small part of the stern sticking up out of the water. The lifeboat we wanted had been smashed to bits. Two or three shacks and a large pile of mussel shells indicated that the survivors had lived there quite a while before being picked up. A great stack of life preservers, some wooden buckets, and homemade bows and arrows with nails for points lay alongside the shelters.

The weather was not unpleasant in the summer, although frequent rains kept the ground from ever drying out. In winter, the terrific winds, usually accompanied by snow and sleet, were very trying. Sometimes the small lakes in the hills froze over in the winter, but the lowlands never froze. Even in the coldest weather there was never more than half an inch of ice on the rain barrel. Snow did not remain on the ground for more than a day at a time.

Geese, ducks, owls, snipe, vultures, grebes, skuas, hawks, teal, gulls, shags, widgeon, and penguins were common. Occasionally we saw black-headed swans. The jackass penguins, which make a noise like a jackass and are a little over

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➤ A MODEL of a Yahgan pit house of the sort used by the natives of Tierra del Fuego and near-by islands.





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◀ THE HUT in which the Hunziker brothers passed two years in the stormy region near Cape Horn, as it appeared in 1915 when the Brewster and Sanford Expedition visited the region.

a foot high, live in burrows under the tussock grass. Their eggs were excellent, and the Yaghans were particularly fond of them. Once, when I accidentally knocked an egg off the table when an Indian was present, he immediately dropped to hands and knees and lapped it up. Not that he was hungry; rather, he hated to see the egg go to waste.

The Yaghans were nomadic canoe Indians without permanent settlements. They moved from island to island as the fancy took them. It was apparent that they camped at the same places time after time, for mussel shell mounds were found on all the islands. These mounds averaged about eight feet in depth, although we saw some more than twice that.

Although small in stature, the Yaghans were remarkably strong. A five-foot, six-inch man was an exceptionally tall Indian. They lived in shelters formed of seal or sea lion skins stretched over a framework of light poles. When traveling, the huts were taken down and packed in the canoes. All the islands lying below Beagle Channel were Yahgan territory.

As steel tools were becoming available, the natives had begun making their canoes of antarctic beechwood. In earlier times, the canoes had been made from the bark of the same tree. These were often 25 feet in length but were quite

frail and rarely lasted more than one year. Usually a fire was kept burning on a bed of sand in their canoes while voyaging. It has been suggested that these fires in the boats prompted Magellan to name the region "Land of Fire," or he may have been referring to volcanoes now extinct. But it seems to me more likely that the name came from the many fires seen on shore. As I understand it, the Yaghans never permitted their fires to die out till they moved their camp. I doubt that canoe fires could be seen from any great distance.

Weather-wise

Although they covered long distances in these canoes, they claimed they had never yet lost one at sea. They were experts at foretelling the weather and were also extremely cautious. Often they waited as long as three weeks for safe weather to commence a trip.

These Indians were adept at making harpoon and spear points from certain whale bones. Spear points more than two feet long, with many barbs on both sides, were sometimes used for fish. Strong, well-designed harpoon heads for seal and sea lion were made with a large single barb, the head being set in a socket in the shaft and held by a thong. We found several flint and stone spear points on Bayly. These were unknown to our Yaghans, but such

points were in use at the time of Darwin's visit in the 1830's.

Most of the Indians were good-natured, but we met one or two of ugly disposition. Three Chilenos with a Yahgan assistant were hunting seals in our vicinity when the Yahgan murdered the Chilenos and made off with the boat. Some months later this Indian, accompanied by his *china* (wife or woman), arrived at Bayly and set up his hut on the beach in front of our cabin. One day, George was walking down to our garden when this man aimed his gun at him and shot. Fortunately I realized what was about to happen and sprang at the Indian. George would probably have been killed if I had not upset the Indian's aim. It turned out the Yahgan thought George was going to visit his *china*; hence the attempted murder. We suggested quite emphatically that he leave the island. He packed up and moved over to Herschel, where he died a few months later. His *china* buried him on the beach by piling rocks on the body.

In the summer months (December to February), we had many visits from the Yaghans, who came to hunt sea otters. These animals, up to 36 inches in length, were killed for food. A few pelts were used; others were kept for trading purposes. The Indians used logs to chase the otters out of the rocks and crevices so they could club them. Often they killed many more otters than they could eat. They kept the surplus meat under water for a month or more and ate it in all stages of decay.

The Indians killed birds with slings and snares. They would sneak up on the nesting birds at night and snare them with a slip-knot of balcen on the end of a stick. It was not unusual for them to fill a canoe with birds in one night.


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When Niagara Stood Still

For 30 frightful hours Niagara's waters ceased to fall,
and the people of the region
were gripped in a nightmare of fear

By HARVEY BERMAN



ON THE evening of March 29, 1848, Jed Porter, an upstate New York farmer, decided to take an after-supper walk. It had been a hard but profitable day, and Porter was content with his progress. The repairs on the barn were finally finished, the fences were up and the seed had been brought back from town. There was a deep satisfaction in realizing that in just a few weeks it would be time to work in the fields again. Warmer weather and the greenery that comes with it were not far off.

Beneath his feet, the earth was still muddy from yesterday's heavy rains, and as Porter walked down the road that wound past his farm and on to the Falls, he calculated aloud just what he would plant this year and where he would put each crop.

Suddenly he stopped. In the few minutes since he had walked out the door, the night had grown strangely still, quieter than he had ever known it before. Bewildered, he remembered that the feeling had come to him earlier in the evening, at supper—an odd sensation of something amiss that you just couldn't put your finger on.

It was all around him in the stillness, this unique something he couldn't quite comprehend. Listening intently, Porter scarcely moved a muscle for a full fifteen minutes. It was then that the understanding

of what it was that was different flooded over him, causing the blood to run cold in his veins and portending doom.

It was the sound of Niagara Falls. That was it. Age after age, the waters had rushed on unimpeded and totally unnoticed. Now the roar was no more. A pall hung over the region as the world seemed to hover uncertainly in the balance.

"What has happened to the Falls?" Porter demanded of himself again and again. In his fright, he refused — dared not — believe what his ears told him.

Suddenly alert, he raced to the chasm, hopeful that with his own eyes he might dispel what he believed to be a fantasy. Reasonably, scientifically, it couldn't be. The river had not in his—or anyone's—lifetime ever stopped coming. Yet, something this evening had brought it to a standstill.

Reaching the rapids, he looked down over the edge, down into the river bed below. By the light of the moon, he became a witness to one of the most incredible sights that man has ever seen. The majesty and power of Niagara Falls were spent. The water had stopped. Far below, Porter could make out patches of drying mud and rock. Nowhere was there water, except for the few scattered puddles left by the rampaging river during the hours that preceded the end.

The strange calm soon affected others. For miles around, people who had gotten used to the rumble of the falls suddenly realized that it was missing. They hurried into their clothes and headed for the high ground from which, on innumerable occasions in the past, they had gazed down at the hurtling torrent and breathed in its majesty.

As the evening went on, a thousand torches soon gleamed in the darkness on both sides of the gorge. People spoke in whispers, not sure of what they were viewing but suddenly terribly afraid. By the next morning, the throng around Niagara had doubled. By noon there were 5,000 onlookers, from as far away as 50 miles, and hundreds of others were choking the roads leading to the dormant falls.

From time to time in the reassuring daylight, the more adventurous spectators descended the steep paths to the river bed below and walked the rocks that centuries of tumbling water had scoured fine. They hunted for arrowheads that countless Indians, generation after generation, had perchance tossed into the rapids as a peace offering or as a sacrifice to the unknowns ruling their daily existence.

With the sun overhead, it was hard to believe the doom that had seemed so imminent in the darkness was coming at all. Gradually,



Harold M. Lambert from *Frederic Lewis*

the fear lifted, and by the time a detachment of United States Cavalry rode down into the river valley and crossed to the other side—the only time in history that men on horseback had ever defied Niagara and lived—the abrupt drying up of the falls became more a thing of curiosity than of terror.

But with the setting of the sun and the end of this first and strangest of all days, the mood that the daylight had dissipated came creeping back. The calm hung heavy over the area, and in more than one farmhouse, a father gathered his wife and children around him, reached for the family Bible, and began to read. By seven o'clock, the churches were open and crowded, as hundreds flocked to special services, with a growing suspicion, expanded upon by the superstitious, that the world was coming to an end.

Well into the night, the anxious lay awake, waiting for a sound that would signal the return of Niagara. It did not come. The night was deep and undisturbed.

Resurgence

Yet miles away, on the now dry river bed, a faint trickle began to work its way toward the rapids. Soon it grew in depth, picking up speed, pushed from behind by the irresistible force that drives a river onward. Those who first heard it

mistook it for the beginning of a light rain. But as it built up, growing louder and clearer, almost as if in anger that it had been held back and that the record of untold centuries had been shattered, the torrent rumbled back. It was a growl; it was a roar; finally it was an upheaval. The ground trembled and farmhouses shook. Horses neighed and dogs bayed at the moon. Plaster cracked and glassware fell from the shelves. And everywhere the lamps were lit, and people for the second time hastened to the gorge.

As one solid wall of water, Niagara returned. The advance section reached the edge and cascaded over. The river bed filled and overflowed, and massive boulders were lifted high into the air and tossed ashore by the rampaging giant.

"The falls are back," mothers quietly whispered to their weary children. "Now we can all get to sleep." And farmers, returning from the spectacle, looked out over their fields in the moonlight and dared to plan again. The long wait was over. The world had begun to spin again.

It was not until months afterward that the truth was finally made known. A team of scientists had analyzed the fantastic event and reported their findings.

Why had Niagara stopped? The explanation they offered was as simple as the 30 hours of silence

had been grim for those who believed they were witnessing the demise of one of the world's greatest natural spectacles.

Early on the morning of March 29, a heavy wind had blown in over Lake Erie. Within a few hours, the lake seethed violently, under gusts ranging as high as 100 miles an hour. Weakened by the warm weather, its ice field broke apart, and sections of it began to move. Tons of ice swept on to Buffalo, and at the entrance to the tributary that feeds Niagara, the mammoth pieces jammed together.

All through the day they piled up, damming the mouth of the waterway. That portion of the river already on its way before the shifting of the ice field, continued. The rest found its route blocked. It was not until the ice had finally moved on to a new position that the torrent was permitted to resume a trip that had been uninterrupted since time immemorial. During the wee hours of March 30, the returning water reached the rapids, aroused the frenzied inhabitants of the Niagara region, and lifted the nightmare that had hovered over them.

The world did not come to an end, and the falls have never again stopped running. The saga of the day Niagara fell silent is an unforgettable example of the sway that Nature, in a prankish mood, can hold over the mind of man.

The Spice Islands Revisited

Experiences on an expedition
to study birds in the storied Moluccas, remote tropic islands of surpassing beauty

By S. DILLON RIPLEY

Peabody Museum of Natural History, Yale University

Photographs and drawings by the author

WHEN I made my first visit to the Moluccas in December, 1936, a friend thrust a book into my hands. It was Alfred Russel Wallace's work, *The Malay Archipelago*, published in 1869.

"Here, take this," he had said. "I understand it's current reading on the islands you're going to."

He was right. And, as far as I can see, he's still right. Time seems to have stood still there since early in the seventeenth century.

My purpose in revisiting the islands recently was to study some problems in bird science. The birds of the Moluccas represent the end products of waves of settlers from near-by larger continental areas. There are far fewer species on the Moluccas than on the large islands nearer the Asian mainland, or on New Guinea and Australia. The main avenues of colonization have apparently been from New Guinea on the one hand, with its specialized ancient Australian-New Guinea fauna, and from the Philippines or the great Malayan islands on the other. I wanted to try to learn something of what happens when species of such diverse origins meet and compete in the same limited environment.

Our plans for this Moluccan visit had of course been in the making for several years. The Indonesian

Government looked with favor on them and proved to be thoroughly cordial and receptive. The Indonesian Government Museum put its facilities at our disposal and even lent us a collector-taxidermist. Säan, as our Javanese assistant was called, proved himself to be invaluable as a general factotum and diplomat. Fortunately my speaking knowledge of Malay, though entirely dormant for sixteen years, came back with a rush a few days after arrival in Jakarta, Java. Without it, we should have been nearly helpless.

From Jakarta, we traveled 1500 miles to the east to the small island of Ternate. This is a few miles off the coast of the largest island in the Moluccas, Halmahera.

The first night of our stay in Ternate, my wife Mary remarked, "If you had taken an atlas and tried to measure the farthest place away from home, it seems to me you would have picked the Moluccas!" Geographically, she was right, and in many other ways as well. This, in spite of the fact that air travel

has brought the Moluccas to within six to twelve days of anywhere on earth.

The town of Ternate is tucked along the shore at the base of the central mountain, which rises sharply to a height of 5600 feet. The view from the town is superb. You look out over the bay to the mountains of Halmahera and near-by Tidore, a neighboring islet with a perfectly conical mountain at its apex. No islands in the world can claim greater beauty than these.

The Moluccas are called the Spice Islands because they are the original home of cloves, nutmeg, and mace. But by the sixteenth century, commercial rivalry over the spice trade and wars between the Dutch, Portuguese, and Spanish had considerably interfered with the economy of the islands, and their fortunes began to decline. In 1628, the Sultan of Ternate signed a treaty with the Dutch, by which the Dutch East India Company took over the entire administration of the spice trade, paid a subsidy to the Sultan, and forced the in-

THE AUTHOR is already well-known through his previous articles in *NATURAL HISTORY*, as well as through his book, *Search for the Spiny Babbler*, which narrates some of his adventures in Nepal. Many other scientific writings round out a distinguished career in bird science. He

is Associate Professor of Zoology at Yale University and Curator of Vertebrate Zoology at the Peabody Museum. His explorations have carried him into many parts of Asia and the Pacific, and he belongs to various scientific societies on four continents.



▲ TIME has stood still in the Moluccas for 300 years, but Ternate has a new look. All its 18th century mansions were destroyed in World War II by American bombers and have been replaced by these modern buildings.



▲ THE AUTHOR'S WIFE buying two tame cockatoos. They were captured as babies in the parental nest hole. Some of these pets learn to talk.

▼ HERDING FISH. The paddlers control float-nets, while a man dives at intervals into the clear water and drives the schools of small fish into them.



▲ WITH A LATEEN palm leaf sail and a reversible bamboo mast, this canoe can take advantage of the faintest breeze. Single or double outriggers help stability.

▼ TIDORE's perfectly conical volcanic mountain, 5900-feet high, as seen from one of the streets of near-by Ternate.





▲ THE COFFEE HOUR at camp on the island of Halmahera. Friends from the nearest village have come to observe activities.



▲ A YOUNG FISHERMAN of Batjan who sold bananas in season.



▲ A PORTER who carried equipment high on Mount Sibela on Batjan. Most of the people of this island have never been into the hills and seem unwilling to go there.



▲ THE HIGHEST HOUSE on the slopes of Mount Djailolo on Halmahera. This woman and her daughter grow sugar cane, coconut palms, cassava, and flowers to plait in the hair—what more could anyone ask?

habitants to cut down all clove and nutmeg trees except those on official plantations on the islands of Banda and Amboina.

Since that time, the population of the Moluccas has been able to support itself with copra and other agricultural products and with a small export of nutmeg and mace, but their level of subsistence is low and their requirements minimal. Even the impact of World War II seems to have done little to change their way of life.

As cook, we recruited a friend of Säan's—a jolly, smiling young man called Ibrahim. He celebrated our first day's bird hunting on Batjan with a slight case of overexuberance. I had run across a goliath

ground cuckoo as big as a pheasant—a huge bird as cuckoos go. Not hearing or seeing anything else around, I decided to shoot it for a museum specimen, only to have the bird lodge high up in a very spiny palm. A great deal of "view-hallooing" ensued, and finally a young man of the local village was heavily bribed to climb the tree and shake down the cuckoo. This done, I sent him off with instructions to give it to Säan to have a skin made of it.

Later, when we returned to camp, we discovered that Ibrahim had been given the bird and, realizing full well that we were queer Americans, had decided that a sort of cuckoo stew was our dish.

Consequently, for one unique meal we consumed goliath ground cuckoo soup. We wouldn't have prescribed this. The meat was black and tough; but of course if you're hungry, anything goes. Ibrahim proved to be a very good cook, not only with our strange dehydrated foods but also with local stews and soups, some of which he made notable by adding onions, pepper, mace, and nutmeg.

Until we came to Ternate, we had never realized that nutmeg and mace both came from the same tree. When full-grown, the nutmeg tree stands about 30 to 40 feet high, and its leaves are glossy and elongate. The fruit looks like a peach in color and size. Strip off

the thick fruit, which is woody and not particularly pulpy in consistency, and you find a dark brown nut the size of a hickory. This nut is the nutmeg of commerce. But it is surrounded by a bright coral-red, pulpy network of plant material, which looks vaguely like a red octopus gripping it. This stuff peels off readily and is dried separately to become mace, turning dark brown in the process.

Batjan, south of Ternate, is an island the size of Long Island, with a central ridge more than 20 miles long. One peak reaches 6900 feet, about the height of New Hampshire's Mount Washington. The island is thinly populated with small scattered villages near the beaches. The 14,000 inhabitants fish, prepare copra, and cultivate cassava plants and bananas.

Our arrival in Batjan created the merest ripple of interest. Certainly there was no burning wish on anyone's part to help us climb into the forbidding, dank, cold jungle of the mountain slopes. We would have to have porters to carry our tents, food, and equipment up into the heights, but we quickly discovered that no Batjan inhabitant

in his right mind would dream of going there. However, the local government official, a Mr. Djugnu, was extremely helpful and went out of his way to persuade one and all to co-operate.

The general ignorance regarding the mountain slopes, the lack of accurate maps, and the total absence of trails make any sort of travel or exploration here very haphazard. With some 20 men finally rounded up by the officials and village headmen, we ascended a hogback ridge to about 1500 feet. Being told that this was the only place where water was available, we made camp in heavy forest. It was here that we managed to see a number of species of Batjan's unique bird fauna. One of these was among Wallace's most surprising scientific discoveries. In his *Malay Archipelago* he wrote:

"Just as I got home, I overtook Ali returning from shooting. He seemed much pleased, and said, 'Look here, sir, what a curious bird,' holding out what at first completely puzzled me. I saw a bird with a mass of splendid green feathers on its breast, elongated into two glittering tufts; but what



▲ THE NATURALIST Wallace was puzzled by the long white feathers that stuck straight out from each shoulder on the male Standard-winged Bird of Paradise, here shown displaying.

I could not understand was a pair of long white feathers, which stuck straight out from each shoulder."

Thus on Batjan in October, 1858, Alfred Russel Wallace caught the first glimpse of the ornithological treasure subsequently named Wallace's Standard-winged Bird of Paradise. Later he saw it alive and wrote:

"The Standard Wing frequents the lower trees of the forests, and like most Paradise Birds, is in constant motion—flying from branch to branch, clinging to the twigs and even to the smooth and vertical trunks almost as easily as a woodpecker. It continually utters a harsh creaking note. . . . The males at



▲ WHEN the banana crop came in, the canoes lay idle on the beach at Wajana. Everybody gave up fishing, copra gathering, and everything else to live on bananas.



◀ A HORNBILL and a cockatoo. The hornbills are as big as a small turkey. The courting males were sometimes seen to swoop down with set wings in a tight series of spirals.



▲ PAPIAN CHILDREN of Misool. The middle boy's parents helped carry the expedition's equipment into the interior.



▲ "MAIN STREET" of Fafanlap village on Misool is a raised causeway of coral boulders and sand connecting the pile-houses.



▲ MRS. RIPLEY and the expedition porters on their way inland in Misool. Incessant rainfall kept the limestone and mud trails slippery, and the weather was hot and damp.

short intervals open and flutter their wings, erect the long shoulder feathers, and spread out the elegant breast shields."

In September, 1954, we caught our own first glimpse of Wallace's Bird of Paradise. Within a few miles of where the great naturalist had stood 96 years before, we saw a male Standard-wing performing. With breast shields expanded and white shoulder plumes erected, it was hopping stiffly up and down a vertical vine hanging from a huge forest tree. The male was displaying to a female near by, and the way he showed first one side of his breast shield, then the other, as he moved up the vine, reminded me of the performance I had witnessed of one of its relatives, the King Bird of Paradise, years before in New Guinea. The males of Wallace's Bird of Paradise call with a harsh "churr."

We were fascinated here by the white cockatoos and hornbills, both of which had large roosts near our camp. I had often heard captive cockatoos give a call, "kut, kut, da-daw-kut," exactly like a hen that has laid an egg, and I had always thought that they had picked this up in captivity, being fairly good imitators. But to our surprise we found at one camp that this call came from a large roost of wild cockatoos, which could not have learned it from a village. Quite evidently it is a natural call among these birds in the jungle.

Hornbills are huge creatures as

big as a small turkey, with mighty wings, long necks, and elaborately wreathed and casqued bills eight or nine inches in length. The males have a rather reddish neck, while the females are mostly black; both sexes have white tails. Near our lowland camp, the hornbills came at dusk to roost in a line of tall kapok trees and emitted a series of grotesque calls—harsh croakings, guttural raspings, complaining noises. The courting season was at hand, and the birds indulged in splendid courting flights, swooping down at times with set wings in a tight series of spirals. The wind rushing through their stiff pinions make a loud "whoosh," not unlike the noise of a jet plane in miniature. At other times, the measured wingbeats of a hornbill, simply flying from one place to another, sounded like a slow freight engine on an upgrade: "chug, chug, chug."

One morning in the jungle we watched a pantomime contest over a potential nest hole high up on a huge forest tree trunk. When we first saw it, a pair of lorries were striking attitudes round it. These brush-tongued parrots are brilliant scarlet, with green wings, and are about the size of a blue jay. One bird, perhaps the male, was bolder than the other and kept going right to the inner edge of the hole to peer inside. The other bird hopped about stiff-leggedly on the trunk rather like a woodpecker. Suddenly all this house hunting went for naught when an irate white cocka-



▲ A MISOOL VILLAGE built over the water, possibly as a holdover from earlier days when the jungle tribes raided the coast. All trade and intercourse is by boat.

too swept in and, with crest raised and wings spread, proceeded to announce its position in no uncertain terms. The lorries did not linger. After all, the hole was probably too roomy for them.

A short time later, when the cockatoo was preening contentedly and seemed to be completely at home, there was a loud "whoosh" and a male hornbill arrived with a thump. With a hoarse roar, it hopped around the trunk, thrusting its bill before it like a cavalry saber. The cockatoo, feathers ruffled again, beat a squalling retreat, and the hornbill perched itself on the edge of the hole. After that, we always saw the male and then a pair of hornbills near that particular hole. So perhaps we had witnessed the actual taking over of the site. We were not there long enough to see any nest-building activity.

A Silent Forest

After a few days we returned and arranged with the headmen to shift our camp to the south side of the range. Here we ascended by a better route and were able to camp at about 4000 feet at the edge of the moss forest.

Each day, we climbed up to the

ridge at 6000 feet, searching for the elusive birds of the Batjan mountains. Thus, for two weeks we were in the constant drip of rain or mist, deep in the forest.

In New Guinea and southeast Asia, mountains such as this are generally lively with bird calls and the varied noises of the other inhabitants, but here the forest was strangely silent. Sometimes one almost walked on tiptoes, for everywhere the silence seemed new, abrupt, as if everyone and everything had just stopped and were waiting, listening for something to happen. But nothing ever seemed to break the stillness except an occasional falling branch or sometimes the bark of a deer or a single bird call. Most often we heard the insistent monosyllabic ascending call of Heinrich's Cuckoo, a tiny, elusive, and largely invisible bird of the highest treetops.

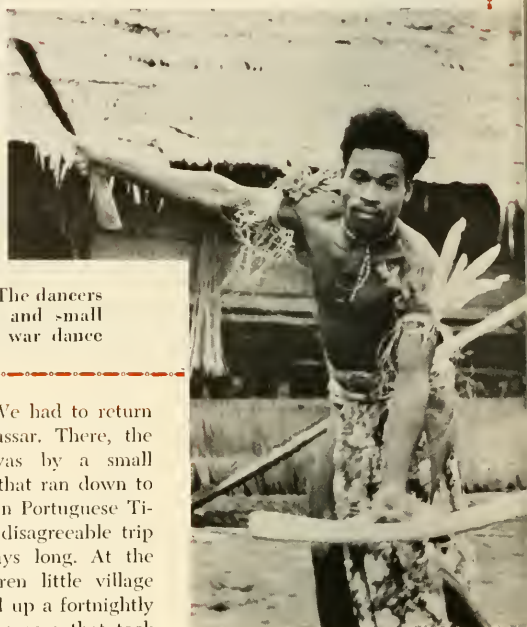
Every evening, rain or not, the silence would be broken by the rasping of the giant cicadas. This incredible chorus, which sounded like a whole series of distant buzz saws, would start up at 5:30 on the dot, swell to a great crescendo, then die down as if a cloud of the insects were flying overhead. Then the noise would swell again, and again

die. So ventriloquial was it that we would search the air overhead looking for the fleeting clouds of insects. But we never saw them and finally decided that the cicadas never left their perches. The effect was simply caused by a swelling of the chorus. The noise would start in one locality, and then insect after insect would take it up over a long distance. Finally those that had started it somewhere down the mountainside would gradually become silent.

The rain at last drove us down again. We had the bad luck to strike a constant spell of it, and our clothes, especially our boots, began to succumb to a rich flora of molds. The damp was so continual that there was no hope of keeping fresh, dry clothes. To add to our miseries, we were attacked by a species of ubiquitous wood mite, which bit and bit and bit. From waist to toes, both of us were covered with literally hundreds of bites, each of which itched fiercely for an average of 48 hours. The men who stayed in camp were relatively untroubled; the mites were mostly in the forest. We tried a variety of sprays and lotions but without great success. In the end, we simply walked down again to the coast and waited for



▼ HERE THE CHIEF'S SON is engrossed in his dance, but he later admitted he would much rather go to America in the author's "canoe."



▲ A CHIEF'S SON on Misool performing a war dance. The dancers wear their best ornaments and carry long knives and small wooden shields. Music for the almost discontinued war dance was provided by a drum and a huge Chinese gong.

the government launch to stop by and take us to other islands.

After two and a half months in Ternate and Batjan, our departure for the second half of our trip in the west New Guinea islands was full of nostalgia. As the steamer whistled impatiently, parting from our new-found friends was tinged with sorrow. As we cast off, the sun was setting in trailing clouds of pink, flame, orange, and mauve, wreathing the fast-diminishing cones of the twin peaks of Ternate and Tidore. A liquid sapphire tint rose up swiftly from the shadows and enveloped us. I nudged Mary.

"Sunset over the Moluccan Sea! It is romantic, isn't it?" And Mary sighed.

Yes, in spite of the difficulties that had plagued us—the delays, the insects, and endless problems—it was romantic. Certainly the setting of the Moluccas is as beautiful and romantic as any in the world.

The last month of our stay in these islands was across the nebulous boundary that divides the new Indonesian Republic from the Territory of Netherlands New Guinea, as it is currently called—the remaining remnant of the former Dutch East Indies. With contact between the two countries discouraged, it proved difficult to travel from Ternate to Misool, a bare overnight

sail to the east. We had to return by boat to Makassar. There, the shortest route was by a small monthly steamer that ran down to the town of Dili in Portuguese Timor. This was a disagreeable trip but only two days long. At the strange, hot, barren little village of Dili, we picked up a fortnightly steamer from Singapore that took us to Sorong. The whole trip from Ternate to Sorong took ten days instead of one as it used to.

Sorong had vastly changed since my visit in 1938. It is now a boom town, full of new buildings of the Dutch oil company and new plans for development. Fortunately we were able to catch a launch to Misool at once.

Sharp Demarcation

Misool is a large neighbor island of Batjan's, of about the same size but without any mountains. From here it is possible to look across the shallow seas at islands in the possession of Indonesia, but what a wealth of change occurs in the narrow strait! The fauna of Misool is far more typically a New Guinea one, with a striking reduction of intermediate species such as we had been studying a stone's throw to the west. Added to that, the people are vastly different. They are Papuans rather than the admixture of racial types, with Malays

predominating, found elsewhere.

The Papuan villagers of Misool are superb hunters with a supreme knowledge of the forest, in striking contrast to the fishing-and-farming people of Batjan. I had only to describe a bird for them to get its native name, as well as a rendition of its song and habits, usually accompanied by vivid pantomime. Moreover, they would leave no stone unturned to rush out and find us a specimen or lead us to a feeding tree where the birds might be found. Other members of the village accompanied by their wives would set out to snare birds alive in neighboring patches of forest. Rails, night birds, and above all various megapodes, which we might never have seen, were duly produced from the snaring activities of our new Papuan friends.

Megapodes belong to a family found only in the Australian-Papuan region, with outliers spreading into adjacent islands like Celebes, the

southern Philippines, and the Southwest Pacific. These birds of several species, varying in size from a partridge to a hen turkey, are close to the family of pheasants and game birds, but they have an extraordinary habit. The hen megapode, assisted by her husband, kicks or claws up a great heap of material into which she burrows, laying her egg at the bottom of a tunnel often several feet deep. Closing the tunnel, she leaves the egg to hatch out on its own, and the baby bird excavates its way out by itself.

Incubation is accomplished in two ways. Some mounds are made of rotting vegetation, and the heat of decomposition is sufficient to hatch the chick. Other mounds, usually on the seashore, are made of sand, and the sun's heat is sufficient to hatch the eggs. Megapode chicks possess fully developed wings, and as soon as they are hatched they are able to fly and lead an independent life. Some day I hope that a study will be made of baby megapodes to find out how they come together with their own kind and eventually assume adult behavior.

We found megapodes of several species on Misool, two more species in fact than were known to occur there. These and a number of other curious and provocative

specimens made our trip highly productive.

When we left, the villagers, pleased with our enthusiasm, organized a dance for us outside the principal house of the chief. Clad in loincloths and decorated with feathers in their hair, the men danced a "tjakalele" for us, a war dance of the old days performed to the tune of a drum and a huge brass gong. They wore arm and leg bands of plaited sennet and carried shields and long knives. The women too performed a "gabba-gabba" dance, a sort of hopscotch. Two women held the ends of two twelve-foot midribs of the sago palm and clacked them together in rhythm, while two other ladies in the middle hopped agilely in and out, their skirts and bushy hair flying.

Outriggers with Matting Sails

After our month of successful hunting, we left Misool to take passage on a tiny coaster to Sorong. The first part of our return trip was made by seagoing canoes equipped with two outriggers, a triangular bamboo mast, and a pandanus matting sail. In a calm sea and with a fair breeze, these canoes can move with great speed, but mostly we progressed by the muscle power of our four paddlers.

Skirting the southeast coast of Misool was like traveling through the mountains of the moon. A narrow channel edged along between huge precipitous cliffs and sugar loaves of weathered limestone. A tangle of grotesque miniature palms had somehow found foothold on these inhospitable precipices, giving a spiky appearance to the vegetation that was well in keeping with the bold rock pinnacles. A few vines trailed down the orange-yellowish slopes, and here and there in crevices appeared the nodding heads of ground orchids, pink and mauve.

As we paddled along the coast toward the village in the distance, we hoped that we might arrive in time to cook a small tuna that one of our paddlers had caught with a line. The prospect was exciting, for it would be our first fresh fish in a long time. With our usual rice, it would provide a welcome change from dehydrated fare.


At that moment, there was a distant sound, and finally we were able to make out a silver Lockheed Constellation flying high up in the pink-edged clouds of the sunset. By taking a bearing, I decided that it must be the weekly Quantas plane on its way from Sydney to Manila. The chances were that by 10:00 P.M. the passengers would be driving into the limousine-filled turn-around of the Manila Hotel. Probably right now the stewardesses were passing out trays of canapes and even a cocktail or two. Soon a piping hot supper would be served to each passenger. I tried to explain to the paddlers, but my explanations fell on unheeding ears. Manila and more distant lands lay beyond their ken.

A few days later, homeward bound again, we started to relax as our big KLM Constellation rose off the airfield at Biak. Savoring a delicious hot meal, we were able to look lazily down on the coral-girt islands, shining turquoise in the sapphire sea below, and to wonder what was going on down there.

"Where on earth are the Moluccas?" I grinned at Mary.



▲ A NEW SCHOOL at Fafanlap carries the children up to about the sixth grade. A few can go on to one of the larger centers like Sorong or Hollandia.



► THE TURQUOISE-BROWED MOTMOT has been a partner of the Feathered Serpent since the days when the Mayas erected their impressive religious edifices.



THE CLOCK BIRD OF MAYALAND

A bird with a tail like a pendulum adds beauty and life to the time-worn temples of Yucatán

▲ THE TAIL of the Clock Bird even switches from side to side like a pendulum.

Drawings by
the author

By ERNEST P. EDWARDS
Hanover College, Hanover, Indiana

AMID the thorn forest of north-central Yucatán, a colorful procession of priests and warriors moved along the causeway toward the great limestone sink they called the Sacred Well. When the first ranks appeared at the brink of the well, a familiar bird darted out of a hole in the rocky walls below and flew up to an open branch in the low jungle. As the bird sat watching the spectacle, its own brilliant blues and rich browns flashed in the sunlight, and its long tail switched back and forth like the tail of an angry cat or like an erratic pendulum.

For many centuries the Maya temples have crumbled, and the jungles have overrun the remnants of the ancient civilization. But as the scrubby forest crept over the ruins and the action of wind and rain and growing roots opened cracks in the walls, the birds of the Sacred Well squeezed between the

rocks and dug deep into the earth inside to build their nests and rear their young.

Today they make their homes in many of the ruined buildings, even entering the abandoned, cave-like rooms to dig into the massive earth-filled walls from within. So, if you take a Caribbean holiday and visit the partially restored archeological sites at Chichén Itzá and Uxmal, you can still see the Turquoise-browed Motmot. In fact, it is probably more abundant than ever.

The Turquoise-browed Motmot, or *Eumomota superciliosa* as it is known scientifically, attracts attention as much for its striking color pattern and distinctive calls as for its switching, "tennis-racket" tail. The Indians named the bird *toh* in imitation of its call, which sounds a little like "tok" and "tok-a-lok." But in Spanish it is called *pajaro reloj*, the clock bird, because its central tail feathers, with their long bare

shafts and feathered tips, look like the pendulum of a clock.

Scientists are not yet in complete agreement as to whether the birds deliberately pluck the barbs from a portion of the central tail feathers or whether the barbs merely come off as a result of routine preening. At any rate, the tail feathers first grow out in a normal shape and then become altered to their characteristic pendulum shape by the breaking off of some of the barbs along the shaft. Considering that the nest tunnel is three to four feet long, with a very small cavity at the end, it is rather remarkable that the birds do not often damage their long tails in entering and departing. Among the motmots of Mexico, four species show the "flag-tipped" tail, while the other two, the Blue-throated Motmot and the small Tody Motmot, have all of the tail feathers complete. The present species is distributed through trop-



Photo by Edward Weyer, Jr.

▲ EL CASTILLO, at Chichén Itzá.

ical Middle America down to north-west Costa Rica.

The Turquoise-browed Motmot seems to be the most gregarious of the Mexican motmots, as well as the most colorful. From the upper platform of the Temple of the Warriors at Chichén Itzá, we could see as many as seven individuals in view at once, scattered below on the tops of the old stone columns. We found the nest hole of one pair in the wall, and judging from the persistence of others in returning to the temple, more nesting places must exist near by. As the birds moved nervously from one column to another, their calls echoed among the columns, and the gray stone courtyard sparkled

with flashes of turquoise blue and emerald green.

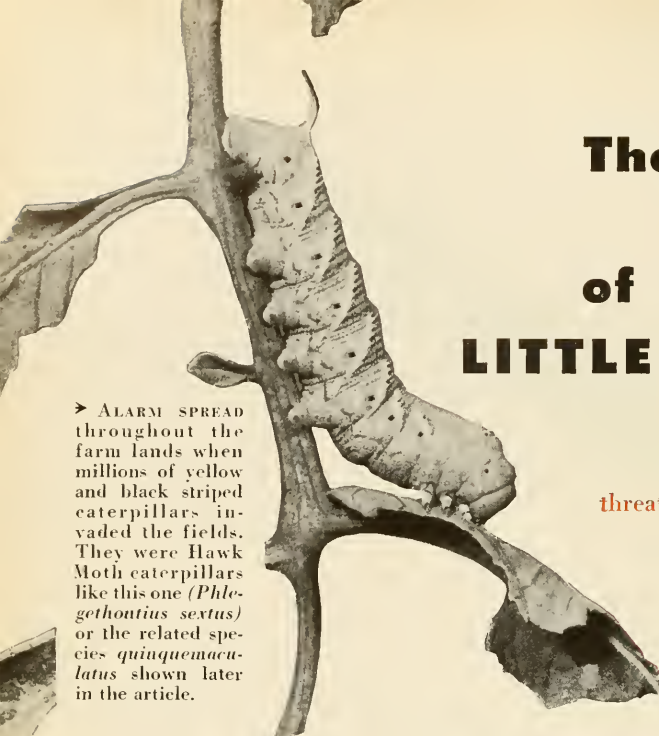
Far to the west near Champotón, we saw what amounted to a true colony of these motmots occupying many nest holes in a small clay bank beside the sea. We could see nine adult motmots in view at one time there, one with a small fleshy fruit in its bill and others carrying insects to feed to their nestlings.

Though the nest chamber may be three or four feet from the surface of the ground and the space within quite small, the parent birds keep it neat and clean. The female lays up to four glossy white eggs, and the young birds are fresh and clean when they finally emerge into the outside world.

Down through the centuries, this strikingly beautiful and conspicuous tropical bird has associated rather closely with man and has apparently lost its fear of him. A tourist

walking among the ruins at Chichén Itzá is surprised at times by the rather bold manners of the Turquoise-browed Motmot. Almost like jays, several motmots may appear suddenly—near the Nunnery, or the Temple of the Warriors, or the Sacred Well—watching the intruder and switching their tails back and forth nervously. One or two will voice an excited "tok-a-lok" and fly closer, alighting perhaps on a nearby plumed serpent's head or on the long curling nose of a stone idol, while others remain watchfully at the edge of the jungle. On other occasions, the birds may seem rather shy, and only one may be seen where several congregated the day before. But whatever the behavior of the Turquoise-browed Motmot on any particular day, an observant visitor to Chichén Itzá can expect to find the bird somewhere about these Mayan ruins.

THE AUTHOR, a graduate of the University of Virginia, got his Ph.D. in ornithology at Cornell. He has made eight trips to Mexico to study birds and is the author of the guide book *Finding Birds in Mexico*, published last year.—Ed.



➤ **ALARM SPREAD** throughout the farm lands when millions of yellow and black striped caterpillars invaded the fields. They were Hawk Moth caterpillars like this one (*Phlegothoutius sextus*) or the related species *quinquemaculatus* shown later in the article.

The *Mystery* of the **LITTLE BROWN JUGS**

When a mysterious “plague” threatened to destroy the crops, an Oklahoma community prayed and a farm lad was able to demonstrate one of the marvels of nature

By HARVEY H. NININGER

Photographs by John H. Gerard
from Monksneyer Press

AT THE turn of the century, our part of Oklahoma had scarcely advanced beyond the culture status of Civil War days. Our country school was ungraded, our teachers homemade with perhaps a few weeks of summer-school veneer. Our preachers were men of the plow who scorned higher education, and “higher education” began at grade nine.

For the boys of our family, the opening of school term had no meaning. We started at mid-term after fall cotton picking was finished, about November 1-15, and we brought our books home about March 1 when spring planting began. Of course there were days during the winter, too, when farm work took precedence and when we were kept at home to work.

But now it was summer and plow time. The cotton and corn showed promise of a bountiful harvest, the wheat had been cut, and I, who was in my middle teens, had the job of plowing under in preparation for the next crop.

A strange and terrible thing was happening that summer. After the wheat had been cut, the usual growth of weeds in the stubble was suddenly attacked by millions of ugly yellow and black striped caterpillars, each with a “deadly” horn surmounting its rear end. They were ravenous creatures, and almost before we knew it they were devouring the “persly” and pig weeds, leaf and branch. Within a matter of days they had grown to a length of two inches; and it seemed a foregone conclusion that as soon as the weeds were finished, the creatures would head for the cotton, corn, alfalfa, and other crops.

They were the sole subject of conversation outside the little

church on Sunday morning, and in the Sunday school classes they were referred to as a plague sent to punish our community for some unidentified sin. From the pulpit this anticipated calamity was compared to the biblical plagues sent to punish Pharaoh of Egypt. Dire distress was in store unless acceptable penitence was expressed for this somewhat vague but certainly grievous sin.

By the following Saturday the repulsive creatures had grown to frightful size, and their food plants had just about disappeared from the stubble fields. Disaster seemed imminent, for evidently they would now march into our crops. Fear settled over the community. Fervent prayers were offered for de-

THE AUTHOR: The experiences narrated in this article may have influenced Harvey H. Nininger as a boy to choose a scientific career. He received an M.A. from Pomona College, taught biology in a number of institutions, and was later awarded an honorary D.Sc. by McPherson College. His scientific curiosity then sought even

wider realms, and he became one of the country's leading experts on meteorites. Since 1953 he has been Director of the American Meteorite Museum, at Sedona, Arizona. He is said to have made the largest private meteorite collection in the world and has written extensively on the subject.—Ed.



▲ A CLOSE-UP of one of the "little brown jugs": the pupa of the caterpillar shown above. During this resting stage, the creature appears to be dead, but it will twitch if disturbed.



▼ EMERGING. Here the pupa becomes an adult moth. The wings are only partly expanded as the creature scrambles from the earth. One of its large eyes, useful in its nighttime existence, is well shown here.

▲ IN THE FINAL STAGE, the Hawk Moth is a hairy insect with long wings and antennae, both folded along the body.





▲ THOUGH SUCH A FATE did not reduce the invasion described by the author, parasitic braconid wasps sometimes spin their cocoons on the caterpillars. The cocoons are about $\frac{3}{16}$ inch long. This caterpillar is apparently *Phlegethontius quinquemaculatus*.



◀ THE INFESTED CATERPILLAR is now in a much reduced state, its body tissues having been eaten away.



▲ THIS IS THE BRACONID wasp that emerges. It is only $\frac{1}{8}$ inch long, but it can cause the caterpillar a lot of trouble.

liverance from this awful menace.

On Monday, I returned to the plow. After all, there was a certain satisfaction in plowing the ugly things under, and each round made with the plow added another eighteen inches to the barren, plowed ground that the survivors would have to cross in going to our other fields where the precious crops were still intact.

A great surprise awaited me. When I reached the field, the caterpillars were nearly all gone! Where? I hurried to inspect the neighboring fields. No caterpillars! Had the prayers actually been answered? Had the Almighty withdrawn the pestilence? The community heaved a great sigh of relief. Whatever had brought on the pestilence had evidently been righted, and our crops were saved. To me, however, the matter seemed not so simple as that.

As I sat on the moving plow that forenoon, I pondered. Also I observed. There were many holes in the ground, I noticed—holes about a half inch in diameter, which I had not seen before. Also, a number of the caterpillars were turned up by the plow. They were inactive, however, and many of them looked misshapen and "sick." This I did not understand.

A few days later I began plowing up odd-looking brown objects, pointed at one end and with a sort of pitcher-handle at the other. Generally these objects were inactive, but if touched, the pointed end would wiggle.

Things like this were not entirely new to me. I had often seen similar but smaller ones when the garden was plowed in the spring. They were commonly called "little brown jugs," and the story was that they turned into butterflies. But this sounded rather "fishy," and I had never found anyone who could prove it. In fact, everybody I knew seemed to regard the story as fiction.

Certainly nothing of the sort was taught in our little yellow schoolhouse, which had neither a library nor, in fact, even a bookshelf. The

same was true of our home. Books on natural history were completely unknown to us. Caterpillars were not discussed in the Bible, or in the Montgomery Ward Catalog, or in the church paper. Magazines were taboo in our house. They were said to contain *love stories*!

Perhaps here was my chance to find out the truth of the butterfly story. I'm afraid I gave the horses more rest than I was supposed to during the next few days, for I frequently stopped to examine these "little brown jugs." I could not help wondering if they were related to the vanished caterpillars.

First Clue

As I knelt in the plowed ground examining a "little brown jug" one day, I noticed a peculiar little lump of something lying near the small end of it. I picked it up and examined it. When I tried to pick it apart, it surprised me by stretching out accoridian-like; and soon I found I held the skin of one of the big caterpillars—head, horn, and all!

My excitement was indescribable. I began examining other "brown jugs," and, sure enough, there was a wad of skin at the end of every one. I had made a discovery! I was really excited!

But it would not do to talk about this either at home or to the neighbors. To explain the disappearance of the caterpillars in terms of a natural process would be to doubt the Almighty's intervention, for which thanks had been expressed sincerely and repeatedly. I myself was a bit frightened by what I had found.

But the urge to find out things was too strong to stifle; consequently I continued to investigate on the sly. When returning to the field that afternoon, I concealed a tin can on my person and returned that evening with it two-thirds filled with moist earth and a "little brown jug" buried in the dirt. I managed to hide it in the barn and then after dark took it to where there was an opening in the foundation on the back side of the

house. There I placed the can out of sight behind the foundation.

It was about two weeks later when, on a Sunday afternoon, we had company as usual and had enjoyed one of my mother's bounteous Sunday dinners. After we had gorged ourselves with watermelon and were sitting out under the big mulberry tree on the north side of the house, conversation among the adults turned to the caterpillar plague and what had become of the ugly pests. Various explanations were offered, but divine intervention was strongly favored. Finally someone said that he had read that such caterpillars changed into butterflies. He said that they were supposed to go into the ground and undergo a change, after which they were said to get wings.

The "brown jugs" I had examined showed signs of rudimentary wing pads under a shiny brown skin, but it was hard to believe that a winged insect could come out of the almost inactive object I had found. My observations *had* proved that the caterpillar had undergone a change, however, so I thought it was time for me to speak. I told them what I had found. All seemed surprised and interested.

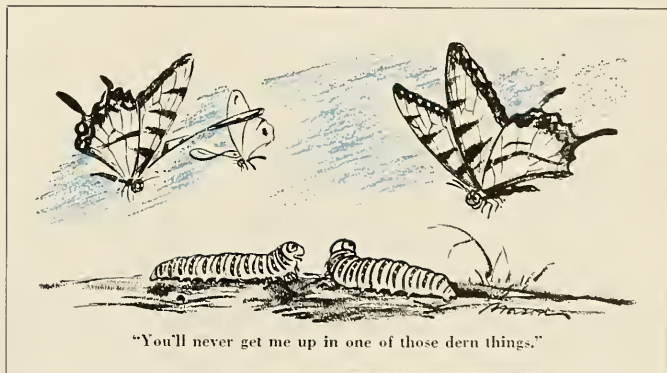
Finally I got up the courage to go around the corner of the house and see if my specimen was still there. I took out the can and was surprised to find the "brown jug" on top of the dirt instead of


buried as I had left it. Placing it on the palm of my hand, I walked around to where the group waited.

As I entered, hand extended, I felt the object suddenly move. I looked at it and saw that it seemed to be coming apart. Its skin had split at the larger end and along more than half its length. As the startled group looked on, a husky large gray moth struggled out of that brown skin. The half-inch wing pads rapidly expanded as when air is forced into a crumpled paper bag, only these grew into flat velvety wings. I was surrounded by a group of white faces and bulging eyes as the newborn, quivering, restless moth crept over my hand shaking its six-inch spread of new wings. It seemed to feel as much at home in its new world as if it had always had wings and had lived in that environment for years.

There are no words to describe the expressions of bewildered amazement and fear that I saw on the faces of the little group around me as they stared at this mysterious and dramatic apparition. For me the experience was almost as if my mind had shucked off an imprisoning shell. I was enjoying the greatest thrill of my life.

Speechless all, we watched the newborn creature exercise its every appendage. Then, with evident confidence, it fluttered away to a nearby mulberry branch. And from the little group of sober-faced onlookers came an audible whisper, "A *miracle*!"





The Galapagos Islands have fascinated naturalists from Darwin to William Beebe, but they never sprang a surprise like this

The Disappearance of Urquina Bay

By JACK C. COUFFER

▼ **NEW LAND.** Until recently, this dazzling white coralline was part of the ocean floor. Now it must be drawn in on the charts as an extension of one of the Galapagos Islands.





▲ THE AUTHOR photographing a Galápagos Hawk in the area that recently emerged from the sea; a scene in the filming of Walt Disney's forthcoming True-Life Adventure feature, "Islands of the Sea."

A MARINER'S chart of the Galápagos Islands lay spread on the deck beside the helm of the 30-foot ketch, *Highlander*. My finger pointed to a bight in the coast line labeled *Bahia Urvina*.

"According to the chart," I said, "this is a particularly dangerous bit of coast. Rocky ledges and reefs run far offshore. Some rocks lie barely submerged by the tide, and there are shoal soundings far out. All that is bad enough, but now, it appears, there is land where there ought to be water!"

The first thing that had puzzled us was Conrad Hall's voice from the rigging: "It looks as if there's

a long white sand beach in there." Hall had climbed aloft to watch for a change in the color of the water, which might indicate a submerged rock or reef. Doug, my other sailing mate, and I were by the helm as the ketch moved in toward the bay from the deep water of Bolivar Channel. We had come to photograph wildlife for Walt Disney's forthcoming True-Life Adventure feature entitled "Islands of the Sea." It began to look as though we might have more than the usual wildlife of the Galápagos to photograph.

The chart did not show any beach where Hall had said there

was one. It showed a bold lava coast—an old flow from the crater that rose steeply from the shore.

Perhaps we had misjudged. Maybe this wasn't Urvina Bay at all. With the pelorus, we took bearings on crater peaks. Our position checked out. We were heading in toward the coast where Urvina Bay should be and where there shouldn't be a white sandy beach.

Closer now, we could see the white shore from the deck, and with binoculars we could detect that the white was not sand. What we saw looked like dazzling white lava boulders piled up to form the shore, but how could lava be

white? Everywhere else it was jet black. The white lay in an even band. A line as straight as the horizon divided the white from the dark lava above it. It was as if the surf that broke white on the black boulders had been paint and had left a clean band along these miles of shore.

Now we were close enough to look for certain landmarks and off-shore rocks that would guide us to the anchorage. But the bearings of shore points didn't jibe as they should with those indicated on the chart. The chart showed many soundings. Someone had been here and had measured water depths; but where the chart showed eight

fathoms, our lead line showed three. Where there should be water, there was a rocky reef four feet above the surface. Where the chart showed a protected anchorage, there was instead dry land.

Afoot on the Ocean Bottom

We carefully felt our way in with the lead line and anchored in a good spot. There was a narrow strip of sand at the head of a skinny thumb of a bay, and we beached the skiff on its smooth slope. Pulling the boat up, we walked over the rise of the beach. A long sandy depression bordered by the white stuff stretched way back from us a quarter of a mile to

where some near-dead mangrove trees stood at the edge of black lava. It was odd, we thought, that mangrove trees should grow so far from the water. Usually their roots are bathed by the tide. We stood at the top of the beach and looked out over the bleached land. It was hard to convince ourselves of what we were seeing.

We walked to the white rocks. The dazzling brightness of the sunlight on them hurt our eyes. The thick, plaster-like coating that covered them had been built up by calcareous algae of the sea bottom. In every niche and crack and cave in the rock was the skeleton of some sea animal—a crab, a starfish,



▲ PHOTOGRAPHING the dried shell of a lobster trapped when the ocean floor rose to become new land. Thirty shells of sea turtles were found in one depression where the water had evaporated.

a sea urchin, a fish. In the depressions below the rocks, the dried remains of lobsters, sea turtles, eels, and marine worms lay mummified by the sun. A very short time ago, all this white coralline had been at the bottom of the sea.

We walked up the sand and through the rocks, inspecting the sea of death. We were like divers unencumbered, able to see the details more clearly, only each detail was dead—bleached white. The dried remains of life were everywhere about us. Brittle stars, shellfish of countless varieties, corals, and the many-shaped exoskeletons of crabs of various species. On the



sand bottom were the dried white discs of sand dollars and other kinds of sea urchins, more shellfish, more eels, more fish. An odor still clung to the spot. Some of the animals that lay in shaded recesses were still moist in their shells, but already a form of land plant had rooted at one spot in the salty sand of the old sea floor.

The fleshy parts of all the animals had not completely dried, and yet there had been time for a land plant to root and grow. We made a wild guess, based on these clues, and decided that the new land had probably risen some two or three months before our discovery.

How fast had the catastrophe overtaken these creatures? We found many dried fish lying on narrow ledges from which, if there had been a gradual lowering of the water, they easily could have swum away. Either the land had risen at



▲ LOOKING SEAWARD across one of the areas of coralline that rose from the sea. The dark material in the foreground is lava.

once in a great submarine upheaval, trapping them on the ledges, or toxic volcanic products had killed them before the land had risen.

Though we found no evidence of the great faults sometimes associated with major earthquakes, we saw here and there new cracks six inches wide. They ran at right angles to the beach line and had broken through massive, solid lava boulders.

Above the old beach line, now nearly a mile from the surf, we found the abandoned nests of flightless cormorants that had been incubating their eggs when the water retreated from their shore-side nesting sites. The eggs were rotten now, and the adult birds were nowhere to be seen. Surely they had escaped to the sea. It must have been a long walk for the clumsy-footed cormorants, and one beset with many difficulties. Under less tragic circumstances, it would bring to mind a comical picture—the awkward gait of the stubby-winged birds hobbling the long way across the rocks to water.

Farther along this dead shore, in mud-walled canals through a now-dead mangrove swamp, we counted

as many as 30 shells of sea turtles in a single dusty depression in the old sea floor. The depressions must have held ponds of water after the land rose. The sea turtles congregated here as the sun slowly dried the land and crowded the sea life into ever smaller circles. Fish joined the turtles in the ponds, along with lobsters and crustaceans of other kinds. No doubt the fish were the first to expire, choking with the fouling of the water.

It was fortunate, we thought, that we had not come sooner. The picture that we visualized was not a pretty one. Now, though death was still here, the struggle was over. The wind blew across the dusty pits of bones, drifting the fish scales into dunes, spreading them across the land.

The shore had lifted highest in the immediate vicinity of the old anchorage. We calculated it roughly as an elevation of fifteen feet. Only fifteen feet, but in an area of shoal water, an uplift of fifteen feet had exposed a great deal of bottom. A piece of coast line stretching for a mile to the north had lifted, and for some three and a half miles to the southward, the white band sloped down along

the shore until it dipped again into the sea. Along much of this coast, the land rises steeply from the water, and where this was the case only a narrow strip of the old ocean floor had been exposed. But in the vicinity of the bay, there was a new land mass a mile wide and two miles long.

We found the blazing equatorial sun almost unbearable when our photographic duties forced us to remain on the bright, reflecting coralline. The intense light burned our already tanned skin a fiery red. The glare from the rocks forced us to squint constantly and soon gave us headaches. Our working time ashore was limited by this and by the rapidity with which the sun tired us.

As we moved from location to location, photographing the curiosities we saw, we could not resist pocketfuls of the many varieties of sea shells that lay where they had died, and I thought what treasure

our find would be to a conchologist.

Everything from the sea bottom was dead. Below the sea there had been much color; now all was white. Where the tide had moved for centuries in restless cycles, it was now a dry and static land, a land of death. But if one stood still for a moment and looked closely, a keen eye could detect signs of returning life.

Pioneers Move in

Here was a spot where terrestrial plants had begun to grow, there a multitude of small spiders that had stretched their tough nets among the gleaming rocks to take advantage of the clouds of flies attracted by the odor of death. A few insectivorous lizards ventured out from the black and into the white to feed on the new land. Birds—flycatchers, warblers, and mockingbirds—had found that it was less difficult to fill their stomachs in this new land. The carrion-feeding in-

sects had multiplied, and we mused that in a short time something that eats carrion-feeding beetles would no doubt find the new white land attractive.

The face of our earth everywhere is slowly, endlessly being changed by the forces of nature—by wind-blown grains of sand, by water-borne specks of silt—and by man. It is a slow change and goes for the most part unnoticed. Centuries are generally needed to make the difference perceptible. But in the Galápagos, among the high-cratered domes, we were made aware that the earth can change suddenly. These are restless islands—restless as the sea that surrounds them. The waves beat against the shore, fires burn beneath the surface, erupting now and then in cascades of liquid rock; the insides growl and moan and belch fire and steam and lava.

Once you sense this restlessness, you are aware of the change that is taking place everywhere. In the



▲ THE AUTHOR surveying a realm he would have needed a diving mask and snorkel to study a short time before.

year to year, and get an idea of what our planet was like in its restless youth.

Four months later, we returned to Urvina Bay. We estimated that the land was now six to seven months old. The spider hordes and flies were gone. Already the bleached whiteness was graying, and the odor of death had nearly vanished. The Galápagos buteo hawk now appeared to be a resident of our new land, and doves and other land birds foraged among the white rocks.

The new shores of the land had gained a richer growth of marine algae, which constitutes a basic food for the life of the coast. Nowhere else in the islands had we seen the green sea plant so luxuriant. The change in balance had somehow nourished the algae, and we fancied that the marine iguanas feeding upon it were generally larger than those we had seen elsewhere. Sea turtles were present in great numbers, harvesting the rich growth. And the flightless cormorants whose nests we had seen above the old shore line were nesting again on the new beach. There were a few more land plants but no new forms. It will be a long time before the salty land will support new growth. The familiar sea birds were there, pelicans and boobies, and there were sea lions on the beaches.

At first we had been amazed and upset by the destruction of life caused by the rising of the sea floor. Seeing the thousands of dead things had depressed us. Then we realized that, given a few years, the dead white zone would become full-fledged land, abounding in life of a different kind. And we knew that what we had seen at Urvina Bay was not a cataclysmic pageant of death but an infinitesimal episode in the age-long evolution of life. It represented but a split second in the cycle of geologic change, which on a vaster scale, has made the world and will continue to remake it time and time again, as long as there is earth and sea and sky.



The Shoestring FERN

Found southward from Florida, it fools people everywhere.

By EDWIN WAY TEALE

ON THE Florida Keys, along the coast, and in the hammocks of the Everglades, a curious fern grows on the palmettos and other rough-trunked trees. Anchored to its support, it hangs down like a mass of round green shoelaces. It seems formed of a cluster of stems without leaves. Natives call it the shoestring fern, the beard fern, or the grass fern. Botanists know it as *Vittaria lineata*. All the year around, the string-leaves of these ferns produce spores in immense quantities.

Rarely found more than a few feet above sea level, the shoestring fern ranges south from peninsular Florida through the Caribbean islands into tropical America. As early as 1753, pressed specimens of the fern reached the herbariums of Europe from the island of Santo Domingo. Thirty-five years later, in 1789, the pioneer botanist Andre Michaux first discovered the plant on the North American mainland during his explorations in Florida.

South of South America continued from page 761

Their principal meat was hair seal, but they also ate sea lions and parts of whales washed ashore. They consumed great quantities of mussels, limpets, and eggs. When fishing from a canoe, they would sometimes drop tiny bits of white shell into the water, which would attract the fish, and the Indians would then spear them.

When dancing, the Yahgans painted their faces with red earth mixed with seal oil. The dancing was always the same and most monotonous: a jumping up and down from a squatting position while throwing the arms back and forth at the same time. On such occasions they wore a special head-dress made from feathers of the *quark* or heron, woven on a plaited cord of sinew. When in mourning, they wore a leaf-shaped piece of goose down above the forehead.

An old Yahgan told me that after a death occurred, the body would be cremated on a pile of wood. As soon as the fire started, they would leave the place, returning after several weeks to complete the cremation if necessary. A Yahgan would never venture into the woods after dark for fear of ghosts. The same man explained with some amusement and zest how they used to kill shipwrecked sailors in the old days, just to obtain the few possessions. Only a few years before our arrival, it was still a custom for a Yahgan who had become old or useless to be taken for a walk along a high cliff and pushed over. Such a death was a favor.

Fights between families were not uncommon, and George and I once went to see what all the commotion was about. By the time we arrived, the women had hidden all the guns and knives. The oldest man, a friendly fellow who knew a few words of English, worked his way to the center of the fight and commenced swinging his large spear. This put an end to the fracas. Turning to us, he patted himself on the chest and boasted, "Strong man, clever man." It almost



AMNH photo by Beck.

▲ CAPE HORN, in the distance, is on an outlying island 200 miles south of the mainland of South America.

looked as if he had put on a show for our benefit. Unfortunately, some interfamily fights did not end so harmlessly.

George and I learned enough Yahgan to make ourselves understood, but we never became proficient. Thomas Bridges, who compiled a Yahgan dictionary of more than 30,000 words, considered the language even more expressive than English.

We increased our income by hunting otters. Our sheep dog helped greatly in this work, finding and bringing in many an animal we were unable to locate in the kelp beds. We sold hundreds of the pelts in Ushuaia for about \$2.50 each.

A False Alarm

One exploring trip to Herschel Island caused a rather amusing incident. Accidentally I started a brush fire, which got out of control and soon reached a small forest, where it burned furiously with a dense smoke. Many months after this, we read a report in an English newspaper by a ship's captain, to the effect that Herschel Island had blown up and was still in a state of violent eruption!

On Herschel Island we found a rookery of sea elephants, the first we had ever seen. The animals mixed freely in the water with sea

lions from a near-by rookery. Fur seals were not often seen, although a rookery was said to exist on Evout Island.

Once, when we were hunting on Wollaston Island, we saw four longboats round a point. We immediately started a signal fire to attract their attention. Seeing the fire, the occupants of the boats sheered off, as if afraid of Indians. From the top of the island we watched them land on Grevy. As soon as the weather permitted, we sailed over and found 25 men making breakfast on the beach. They were from a three-masted French bark that had hit a rock in a blinding snowstorm and had run ashore. We directed the captain to Grandi's place, thinking Grandi might be able to take them to Ushuaia in his power boat.

The next day we boarded the abandoned bark and found that it was from Portland, Oregon, bound for France with a cargo of wheat. Knowing we could sell wheat in Ushuaia, we loaded the *Alfredo* and took the grain to Bayly. Returning to the ship, we then helped ourselves to clothing, hardware, bedding, tools, ropes, tarps, and groceries. The captain arrived at Bayly the following day to thank us for what little assistance we had been able to render, and on the way he had placed a man on the

bark as a guard. When told we had already taken some wheat and supplies, the captain was quite unperturbed. He even wrote us a letter instructing the guard to let us take anything else we wanted.

When later we put out for more supplies, however, we were met by a determined man with a rifle, who told us to stand off or else. After some argument, he accepted the letter and allowed us aboard. Among other things, we took silverware, linens, barrels of wine, cases of champagne, and a hogshhead of rum.

Hermite Island lies about halfway between Bayly and Cape Horn, and it was here that George came across another unrecorded island tragedy. Investigating a rude shelter, he found two skeletons lying outside and another inside. Most sailors rounding the Horn were regaled at some time or other by gruesome but unjustified tales of the "cannibalistic" Indians in those parts, and it may be that some shipwrecked men died because they were afraid of approaching the Indians.

From Navarin Island, where we had been hunting guanacos, we decided to go around to Beagle Channel on the north and pay a call on the sons of Thomas Bridges. I knew Lucas quite well and had met Will and Despard. Our intended visit of a couple of hours was prolonged into three most enjoyable days. We left loaded with gifts; their hospitality was well known. The Bridges' sheep and cattle ranch on the southern coast of Chilean Tierra del Fuego was a wonderful example of what a modern, efficiently operated *estancia* could be. Lucas has recently written a book, *The Uttermost Part of the Earth*, about the Fuegian islands and their inhabitants. He understood the different Indian dialects, often lived with the Indians for weeks at a time, and was about the only person qualified to write such a book.

Curiosity prompted us to visit Cape Horn Island. Many people believe Cape Horn to be the south-

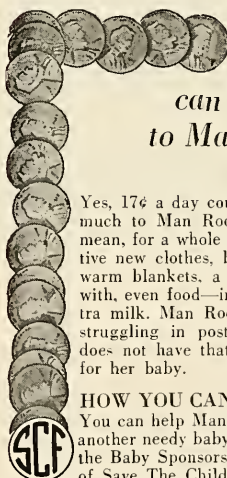
ernmost point of the mainland of South America. Actually the Cape is the southern tip of a small desolate island about 200 miles south of the mainland. We climbed to the top of the Cape, where the island drops off in a rock cliff to the sea 600 feet below. We wanted to sail around the island, but with a storm gathering, we had to hurry away. Departure was not easy. Time and again, as we tried to push our dinghy off from shore, we were either swamped or thrown back on the beach. Finally we made it and considered ourselves lucky not to have been marooned.

We were not the only people to have troubles in these waters. Rockwell Kent wrote a book about his unsuccessful attempt to reach Cape Horn, *Voyaging Southward from the Strait of Magellan*. In it, he tells how he stopped at our cabin on Bayly. The cabin was the noccupied by Argentine seal poachers and was in a filthy condition. In the book there are several fine illustra-

tions of Bayly, but the one entitled "Poachers Cabin, Bailey," left me with a yearning to visit once again those much maligned but to me fascinating islands.

Two years passed quickly, and by then we had come to the conclusion that Bayly was not suitable for sheep. The grassland was fine, but the frequent southwest storms took their toll. Some sheep were lost the first winter, more the second. Only 70 of the original 200 survived after the two years, although we also had about 100 lambs. We decided to leave Bayly with the expectation of starting another *estancia* somewhere farther north. Grandi was leaving his place temporarily, and George had agreed to take care of it till he returned. I made plans for returning to Gallegos. We were fortunate in being able to sell the sheep and lambs and the *Alfredo* to Grandi.

Not long after my brother became established on Bertram Island, Grandi arrived, bringing with



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him a Dutch scientist who wanted to go to Wollaston. Grandi asked George to take the scientist, and a little later, they were overtaken by a bad storm. Waves smashed down on the *Alfredo*, and she soon became waterlogged. Then, to make matters worse, the mast broke. Between them, the men managed to rig up a tiny sail on the stub of the mast and headed for the nearest land. Many hours later they reached a small island off the north shore of Grevy but on dropping the anchor found no bottom. Drifting helplessly, the *Alfredo* was slammed down on a rock and badly damaged. George and the scientist managed to reach shore safely, but as they watched, the

Alfredo slid off the rock and sank swiftly. From beach wreckage, they built a shelter and lived for 21 days on otters, eggs, limpets, and a few birds before being picked up.

The variation of weather in these parts is unbelievably great. In 1883, Captain Willis, in a schooner with no engine, took 110 days to sail from Ushuaia to Punta Arenas, a distance of 280 miles. We once made this same trip in 20 days in the *Alfredo*. As Captain Willis put it, this region "is acknowledged by all nations to be one of the most dangerous places in the known world." For George and me, one of our greatest assets may well have been our blissful ignorance of the dangers.

Our attempt to raise sheep on Bayly was not a failure by any means. We had proved that the island was too far south; no one else needed to try it. We had many hundreds of otter pelts, a cargo of wheat, and a large amount of salvaged material, which brought good money. All of this, plus the sale of our sheep and the *Alfredo*, more than offset our original investment.

But best of all, we had lived a rich two years, a never-to-be-forgotten experience that always recalled pleasant memories.

As this article went to press, NATURAL HISTORY received news that James H. Hunziker has passed away.—Ed.

CAN YOU TRUST THE WEATHER MAN continued from page 351

the machine makes a prognosis of what they'd be a half hour after they were observed. Then it takes that information and makes another prognosis on what they would be an hour later. Then *that* data is used for a third prognosis about conditions an hour and a half after observation. And so on, step by step, at half-hour leaps, until the position of the air masses for 36 hours after observation is recorded. The entire process consumes 92 minutes—if the computer does not become cantankerous.

When the 701 has finished digesting its daily bread, it delivers its views on a chart filled with figures. A member of the Numerical Prediction Unit then traces penciled lines on the charts to illustrate the air flow. The chart is placed over the grid map of the United States, duplicated, and dispatched by teletype and facsimile to weather stations and military posts all over the nation. The machine cannot take into account, in its calculations, the effect of purely local features on the weather, such as the mountains near Denver or the Great Lakes near Chicago. These have to be worked in separately by the local forecasters.

By 7 P.M. daily, 8 hours after weather data has been noted and 28 hours before its forecast is outdated, the computer has completed this job, and you might think it had done a day's work. But it is then turned over to other masters who keep the mechanical wizard busy on research projects for another two hours before retiring it for the night.

How good is the 701 and, for that matter, the numerical prediction approach? Thus far, the system has been used only experimentally, but it's as useful and accurate as any other system.

One thing is certain. The processing speed of the electronic com-

puter will be greatly increased. Ideally, a number of weather observations might be made high in the atmosphere, relayed to the ground by radio, then sent directly to the computer by radio and fed into its innards by a magnetic tape. Theoretically, this might be done. Practically, the steps must be slow and cautious.

But the 701, at best, is nothing more than a tool. "It can do only what a man directs," points out Dr. Pettersen. "It has no imagination of its own. A man can do anything the computer can do if he's given enough time." But the mere existence of this machine has encouraged many meteorologists to tackle problems that once discouraged them because of the staggering mathematics involved. The most important advances of the future will not be technical but theoretical—imaginative leaps that carry weather science gradually upward to new and more penetrating conclusions. The forecaster himself will never be supplanted. He may become less an "artist," but he will become more a scientist. From the standpoint of careers, there is scarcely a branch of science of which it can so truthfully be said that the sky's the limit.



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The Screen

Authoritative comments on films
in the field of nature, geography and exploration



▲ THE MALE SEAHORSE waiting to "give birth" to its brood.



A SPINY LOBSTER, above, begins to moult. Below, the old shell exposes part of the now unprotected body.



The Secrets of The Reef

Reviewed by JAMES W. ATZ
Assistant Curator, New York Aquarium
New York Zoological Society

THE *Secrets of the Reef* is outstanding; it is the best motion picture of its kind that I have ever seen. More than good photography of a worthwhile subject is required to make a top-flight film, but this one has it all—excellent color, narration, music, and photography. Many nature films are being produced today but seldom are they as movingly beautiful as *The Secrets of the Reef*. Even less frequently are they as scientifically accurate.

The script is particularly to be commended for poetic overtones that display a genuine appreciation of the wonder of life and for delightful humor that does not crudely anthropomorphize or poke fun at the creatures whose activities it explains. The music, especially composed for the occasion by Clinton Elliott, complements subject and narration perfectly and firmly establishes rapport between the audience and the underwater world.

This picture took three years to make, and it shows it. To get some scenes the patience and endurance of the camera crew, the director, and the biologists of the Marine Studios at Marineland, Florida, (where most of the picture was filmed) must have been severely taxed. Eight days of ceaseless watching and waiting passed before a male seahorse "gave birth" to his brood. This spectacular event finally

was recorded in the dead of night, with cameramen groggy from lack of sleep but so well rehearsed that they obtained a breathtaking sequence. Other memorable scenes include one during which a spiny lobster sheds its shell and another where a sponge crab daintily covers itself with a camouflage of living sponge.

Zanzabuku

Reviewed by DOROTHY GOODWIN
Film Editor

ZANZABUKU was filmed in central Africa—in Tanganyika, Uganda, Kenya, and the Belgian Congo—and produced for Republic Pictures by businessman-turned-explorer, Lewis Cotlow, who, since 1937, has made several extended trips to Africa where he concentrated on filming wild animal sequences and studying primitive native peoples.

The film (running time, 64 minutes) consists of two parts—a visit to a big animal farm in Kenya, and sorties into open country in search of wild animals, and other adventure. The photography, in Trucolor, is excellent.

The visit to the animal farm is, perhaps, the better part of the film. We are taken on various trips in search of animals requested by zoos, and much interesting footage is devoted to the capture of wild animals, such as giraffes. But, as the commentator says, these trips into the surrounding countryside were too tame for the movie expedition (or was the movie-goer in mind?) and it departed in search of greater excitement and thrills.

Various wild animals—hippopotami, rhinoceros, buffaloes—are pursued and, although the commentator acknowledges that these animals will not attack unless provoked, provocation is not lacking. The result is the showing of several actual attacks on members of the filming expedition by animals disturbed and annoyed by the expedition's efforts to rouse them to action. We do not dispute the contention that this is what the cash customer wants in movie fare when Africa is filmed. We only regret that this is the case, that a film depicting the true animal behavior of wild animals is difficult to get, and, if secured, more difficult still to market to the general public.

YOUR NEW BOOKS continued from page 343

on K2, by radio for the most part. The climbers included eight of the best Italian mountain guides.

Professor Desio deserves high praise for the organization and planning of his expedition, but his book is less successful in this direction. He writes, "I considered it my duty to write . . . a book designed, perhaps, rather for reference than for ordinary reading. In the end I had to resign myself to a compromise." The attempt to blend an account of the scientific work with the story of the climb of K2 does not make for a unified, coherent whole.

Professor Desio, the geographer, is at his best in the masterly chapter, "Geographical Survey of the Karakoram," but for the average reader the most important chapter is the one where we read of Compagnoni's and Lacedelli's determined climb to the summit and their nearly disastrous descent in the dark. The two guides, one after the other, fell off an ice wall and landed "at least 50 feet" below—in soft snow! There were three other unreported falls during the expedition (one of 800 feet), but nobody was seriously hurt.

The use of oxygen undoubtedly helped the two men earlier in their brilliant climb of the summit pyramid, but their good acclimatization was shown by their ability to ascend the last slope after their oxygen supply was exhausted.

The route of the expedition to a point over 27,000 feet was made easier by the fact that it was the same as that of the previous American expeditions, to whom Desio accords full credit. His major technical innovation was in linking all camps on the mountain by a rope headline, perhaps two miles in length. This allowed porters to climb much higher on the mountain than they had gone before and permitted safe descents in relatively bad weather. He also made good use of a windlass to hoist supplies to the lower camps. When he states, however, that "the expedition's success was due first and foremost to the fact that it was undertaken with the specific object of conquering K2, and not merely attempting it," no mountaineer can agree. Weather still controls the success or failure of climbers on any of the big mountains of the world.

Unfortunately *Victory Over K2* must have been hastily prepared, for there are various minor errors. On the American expedition in 1953, Gilkey's body did not come to rest above Camp VII; it has never been found. There is some confusion on the part of the translator in dealing with mountaineering terms such as ridge, shoulder, and crest.

It is a pity that Lacedelli or Compagnoni could not describe the summit climb. The chapter describing their success is dramatic, yet to one who knows K2, the book as a whole does not give the flavor

of the mountain. The mountain Desio describes is the mountain seen from base camp, not the series of snow and rock ridges soaring into the clouds and the little rock platforms where the tents perch on the edge of nothingness and the wind drifts the cold snows.

ROBERT H. BATES

A renowned mountaineer, the reviewer was a member of the American Karakoram expedition which reached 26,000 feet on K2; he is the author of articles and books on mountaineering, and is the co-editor of the American Alpine Journal.

HUNZA;

Lost Kingdom of the Himalayas

----- by John Clark

Funk & Wagnalls, \$5.00, 270 pp.

THIS is a description of an American geologist's attempt to conduct an "experiment in living" in the remote Karakoram valley of Hunza. Financed by a few friends incorporated as the Central Asiatic Research Foundation, Dr. Clark went to Central Asia on a scouting expedition in 1948. He was looking for "tribes of people who had basically good intellects and strong bodies, but who lacked natural resources." Ultimately he chose the Hunzas of northern Pakistan as the most hopeful group.

Returning in 1950 with a ton and a quarter of equipment, he established headquarters in an ancient castle loaned him by the Mir of Hunza. He established a woodcarving school for Hunza boys, and encouraged the commercial growing of wildflowers for seed sale in the United States. He also held daily clinics which, he reports, treated more than 5000 people in 20 months. Most important to Dr. Clark was to find if an isolated people were capable of recognizing the value of an alien philosophy and learning it, or if they could only memorize techniques.

The author is at his best when describing ancient Hunza customs and the daily life of the people. His descriptions of the riotous Tumshuling, the barley-harvest festival and the leave-taking ceremony will add much to other reports about these sturdy and fascinating people.

In a foreword, the author notes that he has "deleted as many as possible of the incidents involving people who were opposed to me or my program." If that is so, the way of the self-appointed missionary must indeed be hard, for those that remain are almost enough to fill the book.

Dr. Clark found he had to combat lassitude, illiteracy, tradition, and local officialdom. Apparently the most successful feature of his visit was a series of prospecting trips in the Hunza area, results of which were reported to the Pakistan Government.

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painter in the depiction of ancient carved surfaces, was a colleague of field archaeologists, and worked in the Near East, Southeast Asia, the Far East, and Central America.

The story of archeological discoveries is informally told, at times with all the excitement of a good detective story. A by-product of the record is an appreciation of the improved archeological standards between two generations. In 1905 a scared little boy was lowered into a newly-discovered tomb to hand out samples of the finds, without regard for possible damage or precise recording. That tomb was cleared out in three weeks! By contrast, in 1926-27 the painfully meticulous clearing of the secret burial of Queen Hetepheres required ten months.

In 1907 the patron of an excavation was so eager to find the tomb of Queen Tiye that it took nearly forty years to establish the fact that the burial found was that of a young king. On the other hand, in 1927 an American excavator faced the disappointment of an empty coffin and ingeniously spelled out a working theory to account for this.

The trained and perceptive artist is a specialist. Smith's specialty was Egypt, where he worked through 2500 years of Egyptian production and came to the firm conclusion that the best of Egyptian art was in the earliest major period, the Pyramid age, and that all later work fell off from those high standards. He was able to substantiate that impression in the art of other cultures, as in Central America. Although Smith felt dissimilarity between the Egyptian and the Mayan pyramids, it seemed to him that the two peoples were remarkably similar in using architectural space to produce an effect of majesty. In the Far East he did not perceive a similar effect.

This readable book is a very rewarding study of ancient man.

JOHN A. WILSON

An orientalist and Egyptologist who has written widely on his subject, the reviewer is Professor of Egyptology at the University of Chicago.

AN ATLAS OF ANIMAL ANATOMY FOR ARTISTS

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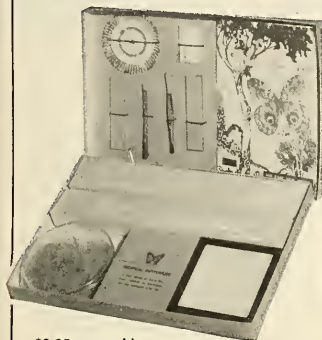
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GEORGE F. MASON

The reviewer is the author and illustrator of a series of books about animals.

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Letters

A Master Mason

Sirs:

Enclosed is a picture I have taken of a rock house fastened to the limb of a creosote bush. It was found in Dona Ana County, New Mexico, near Mesilla Park. Could one of your experts identify the insect that built it?

CLARK CHAMPIE

El Paso, Texas

John C. Pallister of the American Museum of Natural History offers the following answer.

Many female mason bees build curious homes for their young. This one made by *Anthidium consimile*, or a close relative, is elaborately decorated on the outside with bits of stone.

The bee starts by modeling a single clay cell on a branch. She molds the interior of the cell to her own size, with a little space left over, for she has to provide a nursery large enough to accommodate a supply of food and her growing youngster too. When the cell is built the bee starts collecting pollen, carrying it to the cell in the special pollen-holding hairs which cover her body. She makes many trips to neighboring flowers until she has gathered the right amount. She kneads the pollen with a little nectar to make a thick paste, which she packs in the bottom of the cell. She then deposits one egg on the food and the cell is ready to be capped with clay.

The style that distinguishes this bee as a master craftsman is the exterior finish of her cell. Small pebbles or bits of broken rock cover the entire surface. What a task it must be for the bee, less than an inch long, to transport by air these, to her, giant boulders to the cell where they have to be molded in place! Fluids from her mouth help to make the clay workable, which when dry is hard and resistant to the weather.

If the site selected for her first cell continues to her liking, she will add more cells (rarely more than eight) until the group looks like a wad of stone-encrusted clay, as in the picture.

Do Hummingbirds Only Hum? The Male Broad-Tailed Whistles!

Sirs:

On May 19th, while I was walking through the woods near my home, I saw a hummingbird that was making a peculiar noise similar to the buzzing a locust makes when it flies, but it was also like a trilled chirp. At the same time it was flying up vertically in short spurts to about 20 feet, making the trill with each spurt. Then it made a power dive, trilling all the way, stopping just before hitting, then repeated the process.

Then I saw there were two birds and the first chased the other away. Then it



flew to a nearby tree and sat there a while. Every few minutes he would fly away, making the trill whenever he was flying, then returning shortly to the same tree. Twice the other (or another) hummingbird came back and he left his tree and chased it away again. I watched him for about twenty or thirty minutes and after each flight he returned to the tree.

I moved on, but soon saw another one that was doing the same thing: sitting in a tree, flying away, trilling every few minutes, and once chasing away another hummingbird.

All these hummingbirds were of a type that has a metallic-green back and a bright-red throat.

I thought maybe they were males who were setting off their nesting territories before the females arrived from migration. I wonder if you could tell me if it was that, or what?

PETER GARDNER

Williams, Arizona

Dr. Dean Amadon, Curator of Birds at the American Museum of Natural History, clears up the matter for us.

The hummingbirds observed in Arizona were probably of the species known as the Broad-tailed Hummingbird. The males of this variety produce a rather noticeable trilling or whistling note in flight. This is not vocal but is caused, rather, by the rapid movement of the outer wing feathers which are narrow and stiff. Hummingbirds are very pugnacious and each male has a special territory which he defends. Probably the flights observed were a part of territory defense, or possibly related to courtship. In some related species of hummingbirds, whistling sounds are produced by the wings or tail only when the bird is performing sudden dives during courtship. The female lacks the modified outer wing feathers.

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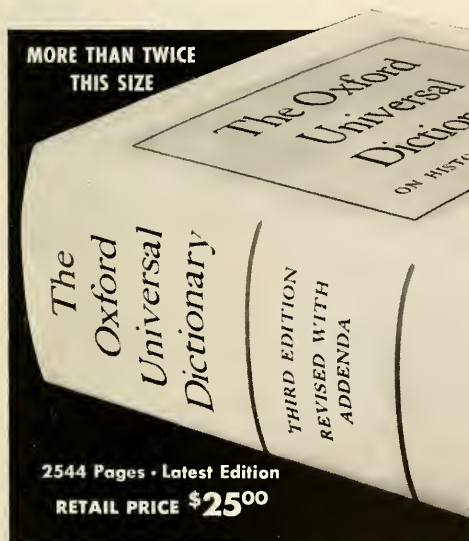
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October, 1956 Volume LXV, No. 8

Vermont Covered Bridge

Cover Design

From a color transparency by Will Bragg

Your New Books

396

Ancient American Goldsmiths

Dudley T. Easby, Jr. 401

The gold work that motivated centuries of exploration in the New World would tax the talents of our best craftsmen, yet only now does it become known how they produced it.

A Living Luck Charm

N. Pelham Wright 410

Instead of a rabbit's foot, Mayans wear a living beetle symbolic of legend of tragic love

City of the Dead

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A rainstorm, a letter, and a teakettle write a romantic page of history with the exotic Bird of Paradise flower

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In answer to inquiries from our readers regarding jobs in the National Park Service, a Park Ranger's wife tries to help you decide if this is the life for you

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THE COVER THIS MONTH

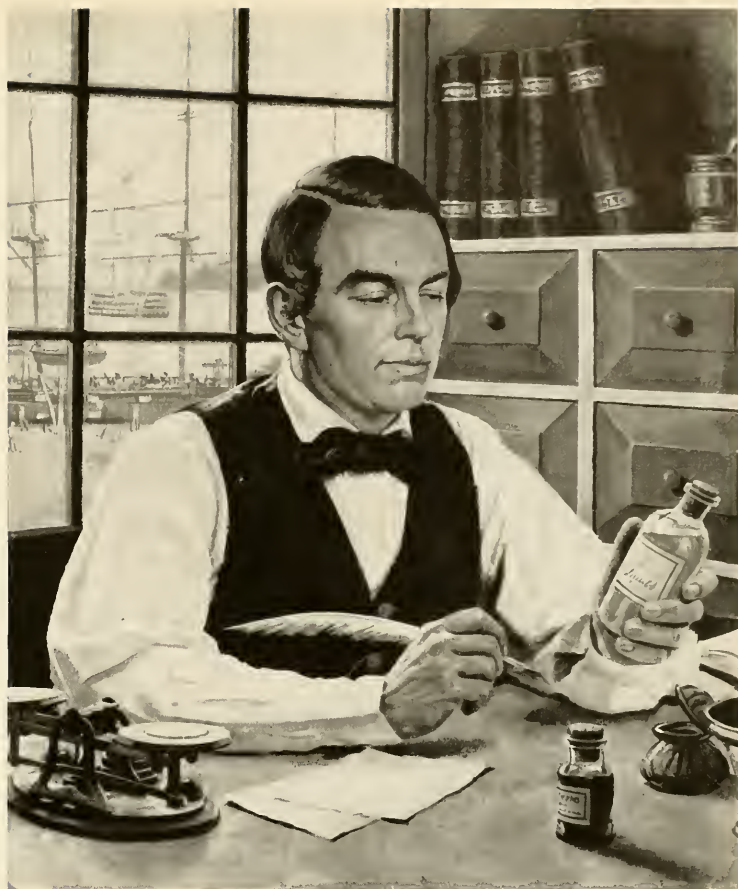
The covered bridge, long familiar in countries like Switzerland and England, first became a part of the American scene in the late 1700's and early 1800's. It seemed to develop naturally and ingeniously as our forefathers discovered that good fording places across streams were not plentiful enough for their needs. They then built small bridges by putting poles across two fallen logs, but found these soon weakened with constant use and the battering of the weather. It became necessary and judicious (for more durable bridges saved the taxpayers' money) for supporting trusses and a roof to be added. The roof helped to keep the roadway dry and free from the dangers of rotting, freezing, or drying. Covered bridges had the added advantage of looking like barns. A horse who was timid when it came to crossing a raging brook on an open bridge calmed down considerably when the bridge resembled his familiar barn.

The covered bridge on the cover, located in Newfane, Vermont on Route #30, is one of a diminishing group of bridges which are monuments to the ingenuity and industriousness of 19th-century carpenters and engineers.

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by HENRY M. NEELY

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THE NAKED AUCAS

by Rolf Blomberg

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by F. H. Lyons

George Allen & Unwin, 21s

191 pages, photos, maps

Reviewed by M. W. STIRLING

TRAVEL and adventure books with a South American jungle setting have been appearing with some regularity during recent years. This reviewer has perused many such books consisting of fictionalized accounts of snakes, ferocious animals, attacks by savage Indians and the like. The result is a completely false impression of conditions in this vast and interesting part of the world.

Blomberg has a somewhat different approach. There is plenty of blood and thunder but it is mostly contained in stories excerpted from the oral and written literature of the country, or told to the author by old residents or recent commercial explorers of the Andean Oriente. Most of the accounts of the latter are no doubt true.

Mixed in with these tales are a few stories of hidden treasure which serve to add spice of another sort. The author manages to give all these accounts a personal touch by projecting himself into the interviews with the old timers and by following up the stories of hidden treasure with attempts to locate the hiding places. The author is an excellent writer. He is even able to turn the discovery of *Chantre y Herrera* on a library shelf in Quito into an adventure.

His interest in the Aucas was stimulated on an earlier trip when he first heard some of the stories of their hostility to strangers. He resolved to try and establish contact with them, mainly, as he frankly states, out of curiosity and a spirit of adventure—and incidentally, no doubt, to get material for a book.

In recent years the "Aucas" have become notorious as "killers." But the term Auca is a Quechua word which simply

means "wild Indians." It is applied generally to the wild or unchristianized tribes east of the Andes.

As a result of new exploitation in their vicinity during the last decade, the term "Auca" has recently been used to apply to the Zaparoan tribes. In the various hostile actions that have transpired during this recent period it is not always easy to name the particular group involved.

Blomberg is well aware of the confusion in tribal nomenclature that exists in this region and the constant shifting of territory that has taken place. He identified the most active group, and the one probably referred to under the term "Auca" as the Aushiri, or the Awishira, as anthropologists now term them. This is probably the same group that recently killed 5 American missionaries but as this book was written in 1949 this episode is not mentioned.

His personal adventures in Auca country take up only a small chapter near the end of the book when with a photographer and an American missionary as companions, he made a somewhat pointless trip into Auca territory in the hope of establishing contact with the Indians. Guided by planes from the nearby Shell Mera petroleum camp, they attempted to visit one of the Auca community houses previously seen from the air. The trip failed in its purpose, and terminated in an ambush attack by the Auca, in which no one was hurt.

The author has made a real effort to assemble information on the history, ethnology and character of the Awishira. This he presents impartially and uncritically; thus some of it is conflicting, particularly in regard to "Auca" character.

The net result is a pretty good picture of past and present conditions and the general nature of this primitive tribe, typical of the Montaña type. Mixed in are glimpses of life on the frontier, of oil camps, missionaries, and tropical tramps.

Director of the Bureau of American Ethnology, Smithsonian Institution, the reviewer has headed many expeditions to Central and South America.

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- Edited by William L. Thomas, Jr.

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1193 pages, illus.

Reviewed by ASHLEY MONTAGU

THIS magnificent volume is the result of three years of planning by the staff of the Wenner-Gren Foundation for Anthropological Research. The original idea for this symposium was conceived by the editor, and it was largely in his capacity as Assistant Director of Research at the Foundation that this symposium on *Man's Role in Changing the Face of the Earth* has been brought to so successful an issue. For what this volume represents is the expression of the considered opinions and conclusions of seventy of the world's leading authorities in the general area of man in relation to the earth upon which he lives.

From the 16th to the 22nd of June, 1955, most of the authorities contributing to this volume spent their time in the pleasant environment of Princeton discussing such problems as how much man has changed the earth's surface, how fast he is changing it, and how rapidly he can restore it as his changes have proved unwise or are now outmoded and require replacement. Other questions considered included: what are the known problems, what special strategy is called for planning in research, and what topics and areas are principally in need of additional investigation.

Since their contributions had wisely been completed and circulated among the participants before the meeting, the discussions, which are most readably summarized in the present volume, were very much to the point. Indeed, the actual symposium discussions are among the most valuable parts of a most invaluable book. The summaries by the three collaborating editors, Professors Carl O. Sauer, Marston Bates, and Lewis Mumford are masterly. If this "plundered planet" ever ceases in human time to be violated, it will in large part be the result of the implementation of such ideas as are expressed in this notable volume, a work which is extraordinarily interesting and of the first order of importance for the welfare of all human beings.

Anthropologist and social biologist, the reviewer is the author of many books and articles in his field.

ZANZABUKU

----- by Lewis Cotlow

Rinehart, \$5.00, 370 pages

Reviewed by STUART CLOETE

FOR animal lovers, *Zanzabuku* is, in a sense, a tragic book. It is a tale of the shrinking world of wild animals and primitive men in Africa under the impact of modern civilization. "Civilization, which has been nibbling at its edges for almost a century, is now biting out great chunks of Africa," says the author. Wild animals are being driven further and further into the mountains and forests. Even the animal reserves are being threatened. Africans armed with guns are killing them off, others are snaring them by the hundreds, with hooks fastened to ropes stretched across vast areas into which every living thing is driven.

Today, however, there is still plenty to see in Africa, and Lewis Cotlow tells us about the real Africa where the ancient past coexists with the present—Africa, where we can go through a hole in time and visit and talk to prehistoric man. Pygmies in the Ituri forest, leopards, lions, elephants, hippo, buffalo are still to be seen. Here is adventure and fact.

Things are not merely stated, they are explained. The Watussi people are the greatest high jumpers in the world but use a little mound for a take-off. A python cannot constrict unless it has its tail around a tree or rock. There are stories of rhino, and of people; Cotlow tells us about the Masai, about the Turkana, and closes his book with some very perceptive and unbiased remarks about colonial administration.

Zanzabuku is a book that is well worth reading. Anyone interested in Africa's flora and fauna, and the people, both black and white, will find it a very rewarding experience. The style makes for easy reading and it is well illustrated with photos.

The reviewer has spent much time in Africa, was a rancher in South Africa for ten years, and has written extensively on the subject.

continued on page 148

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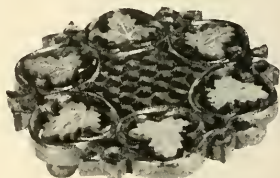
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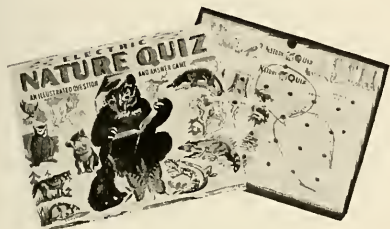
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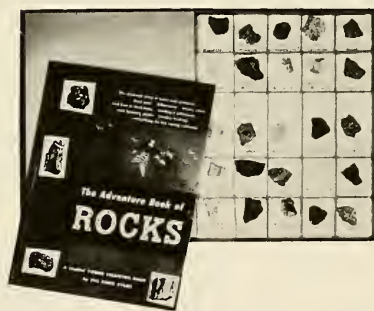
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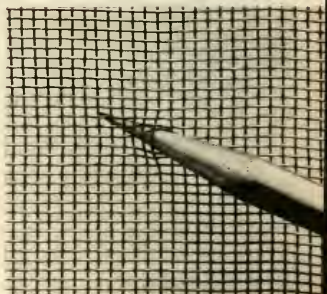
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▲ A GOLD LIP PLUG from Mexico. The snake's tongue is movable and was made separately. Mixtec style.

Ancient American Goldsmiths

The gold work that motivated centuries of exploration in the New World would tax the talents of our best craftsmen, yet we are only beginning to understand how the Indians produced it

By DUDLEY T. EASBY, JR.

CELLINI, the celebrated Renaissance goldsmith, is said to have tried in vain to discover exactly how a jeweler of ancient Mexico had made a fish of silver with a delicate inlay of gold. And Albrecht Dürer, another Renaissance master, frankly marveled at the talent of the Aztec craftsmen. Even today, experienced metallurgists

have questioned whether modern jewelers, with all their twentieth-century equipment, could duplicate some of the masterpieces turned out by the Indians before the Spaniards conquered them.

In ancient Mexico, gold was highly regarded as an item of tribute and also had religious connotations. Its Aztec name was *teocuit-*

latl, literally "excrement of the gods." The goldsmiths had their own special deity, *Xipe Totec*, and anyone guilty of stealing a gold object was flayed alive to propitiate this bloodthirsty god.

The goldworkers, a highly respected group, came to exercise their skills to the exclusion of all other work. By the time of the



National Gallery of Art, Washington

Spanish Conquest, they had achieved a degree of specialization that would put any modern labor union to shame.

Friar Sahagún, the sixteenth-century historian, mentions two main categories: the smith who hammered or beat gold and the founders who cast it. Within those categories the craftsmen had separate names, depending on the kind of object they made. In Montezuma's time, the goldworkers had their own center in Azcapotzalco, a short distance from the capital. Unhappily, however, no remains of their workshops have survived.

Goldworking does not seem to have reached Mexico until the Toltec Period, about A. D. 900. The Mayas to the south, with all their mathematicians, astronomers, architects, sculptors, and lapidaries, produced no goldworkers. The gold hoard dredged from the Sacred Well at Chichén Itzá in the Yucatán peninsula was probably brought in by trade. It consisted mainly of

◀ A TYPICAL EXAMPLE of casting and stretching by hammering: a seven-inch breast ornament of Tolima style from Colombia. The facial features and a rough "blank" of the rest of the object were cast in one piece. All but the head was then stretched by hammering. These objects were not annealed after the final hammering and as a result are extremely brittle.

thin gold plaques, imported from farther south, to which local workers added low relief or repoussé decoration. The craftsmanship is superb, but even this relatively simple technique was unknown before the Toltecs of Mexico introduced it at the end of the tenth century. Some goldwork from the Valley of Mexico resembles jewelry from as far away as Panama and Costa Rica. And, curiously enough, legend has it that the god of the goldsmiths, *Xipe*, came from the south.

The small drawing below shows that the office of goldworker was hereditary in Mexico. These artisans were free to barter their products in the fabulous market place of Tlatelolco, described by Cortes, Bernal Díaz del Castillo, the Anonymous Conqueror, and other eyewitnesses. There were booths for trading gold objects, and also those that handled the raw material, gold dust and nuggets.

Not so at the other end of the Golden Axis of the New World. In the highly organized state of the Incas of Peru the goldworker (*kori-camayoc*) was not a trader but is said to have been a full-time government worker in the local bureaucracy. Goldworking began in Peru about 1,000 years before the birth of Christ, but almost nothing can be surmised



▲ THE FACT that gold working was hereditary in ancient Mexico is deduced from this illustration from the Mendoza Codex showing a metal worker teaching his son the use of the blowpipe.

about the workers before the Incaic Period in the fifteenth and sixteenth centuries. As in Mexico, the office was probably hereditary.

Fine metalworking reached a high degree of proficiency among the Chimu of the desert coast of northern Peru. Their kingdom arose about A.D. 1200, and when they were finally conquered by the Incas, around A.D. 1450, their best goldsmiths were carried off to work at the court in Cuzco. At the Chimu capital of Chan-Chán, near present-day Trujillo, some remains of an extensive metalworking industry are still visible, but no representation of a metalworker has ever been found. This is curious, considering that the many products of the potter's art portray almost every other aspect of daily life.

Colombia has long been distinguished for the excellence and variety of its ancient gold ornaments. There is a museum in Bogotá devoted entirely to ancient indigenous goldwork.

A somewhat apocryphal tale persists in Colombia that throws light on the esteem in which the craft was held. A local chieftain had many skilled goldworkers, whose services were in great demand. He refused, however, to lend any to a neighboring ruler unless he received two hostages for each artisan. The neighbor, being crafty and ambitious, conceived the idea of sending two of his best and bravest warriors in each of the many exchanges that followed. Then, at a given signal, his "Fifth Column" suddenly rose and seized the domains of the goldworkers' chief.

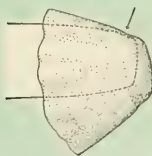
Apparently commerce flourished between the Chibchas on the plains of Bogotá and their neighbors. Unworked gold was sometimes exchanged for salt and emeralds. In



▲ A WOODEN FORM and the effigy beaker shaped from it by the method described in the following drawings.

After Schmidt

1. First step in shaping a vessel like the one shown at left is to sink the center of a thin sheet of gold in a concavity in the end of a log.



2. Here the metal has been placed over a piece of hardwood, and the first round or "course" of hammering has begun to raise the sides of the vessel.



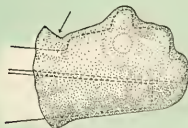
3. Still in position on the form, the metal is being stretched toward the mouth by hammering.



4. Continued hammering displaces the metal toward the front, where the face will be shaped in high relief.



5. Now on a new form, which would be called a snarling iron today, the bulge or "boss" for the face is being knocked out by reperussion with a springy anvil. The left hand arrow shows where the form is struck. The right hand arrow indicates the force of reperussion.



6. A wedge is now placed behind a carved wood pattern and the craftsman has begun to narrow the neck of the vessel at the arrow.

7. The final step: flattening the base of the beaker by hammering over a flat anvil.



fact, the god of the merchants, *Chibchachun*, was also the deity of the goldworkers and was propitiated with gold offerings. The Spanish authority José Pérez de Barradas mentions special places known as *Patios de Indios* where the Indians set up their forges and foundries for working gold, and he laments that not one has been excavated scientifically.

The fine jewelry of Ecuador has been described by archeologists and metallurgists, but little can be said of the men who made it except that they were several hundred years ahead of the rest of the world in using platinum. A temperature of 3,223.8 degrees F. is necessary to melt platinum, and the Indians had no way to produce such heat. But they were able to use platinum by

mixing fine grains with gold dust and alternately heating the mixture with a blowpipe and hammering it until it became a homogeneous mass.

This was the first crude beginning of "powder metallurgy," arrived at independently and then lost, to be re-invented in Europe in the nineteenth century. Today, powdered metal is forced into strong molds under hydraulic pressure (replacing the Indians' repeated hammering) and heated to incipient fusion—or, as we say, "sintered."

The products of the aboriginal

► IMPLEMENTS used by the gold workers of old are extremely rare in archeological collections, but occasionally a refractory clay crucible has been found, like this one from Colombia.

Panamanian and Central American goldworkers, like those of Colombia, show great talent in casting and then forging to stretch certain flat elements. An example from Colombia is shown on page 402. In this area pieces were set with precious stones occasionally, a technique also used in Peru and Mexico.

People express surprise that gold should have been worked in these



After Uhle



National Gallery of Art, Washington

▲ **COLOMBIAN BREAST ORNAMENT** of gold, seven inches high, showing a cast spiral ornamentation common in Colombia, Panama, and Mexico. This was cast from wax threads and soldered on. The sheet forming the legs and body was stretched by hammering, and the parallel bands on the "face" were made from braided wire soldered onto thin narrow sheets. The bosssets or semi-spheres were hammered separately, then riveted onto short stems and soldered to the plaque.



▲ **AN OUTSTANDING EXAMPLE** of single-piece casting, from Panama. A wax model of the finished object was embedded in clay and charcoal and then melted out to provide a mold, as described in the article. The small projections remaining under the feet show some of the places where air vents were provided. These twin warriors with paddle clubs represent the Bat God of Coelé.

regions before copper, which was the first metal used in Egypt and North America. The explanation is simple. Gold in a relatively pure state was conspicuous and readily available in stream beds. It was pretty and caught the sun's rays. It was easy to work, and it did not oxidize or corrode. The Indians worked virgin gold, not gold won from auriferous ores by smelting. Despite early Spanish tales of gold mines worked before the Conquest, there is no proof that gold ore was ever smelted in pre-Columbian America.

The volume and value of gold jewelry produced in America before the coming of the Europeans was enormous. The Spanish chronicles give inventories of loot *ad nauseam*, running into the millions of dollars. But next to nothing was recorded on techniques. The one truly outstanding contribution is

Friar Sahagún's sixteenth-century description of casting from wax models, written in a phonetic transliteration of the Aztec tongue. If one has patience to unravel the original version with an Aztec grammar and vocabulary, it is an astonishingly accurate job of technical reporting. With very few changes it might have been written yesterday or today.

Fortunately, the objects themselves tell their own story of how they were made. The rarest treasure house of technical information is the partially worked or unfinished piece. Certain gold-platinum pieces from Ecuador are in this category, and so are the twin warriors with paddle clubs from Panama shown above.

Without doubt, the first step in the long evolution of working gold was the crude shaping of a nugget by grinding and hammer-

ing. It is almost too much to expect to find many such objects at this late date, but George Grant MacCurdy described two in 1911 in his monumental study of the Chiriqui part of Panama. One of these is reproduced on page 405.

Annealing Discovered

The early craftsmen could produce ingots of workable size by fusing gold dust and small grains, with a blowpipe to quicken the flame. Aztec drawings show goldworkers using the blowpipe, and Sir Walter Raleigh reports its use in the Guianas. The earliest work on metallurgy in the New World, published in 1640, mentions blowpipes, adding that bellows were unknown before the Europeans introduced them.

Some long-forgotten smith in Peru or Colombia must have observed that after cold-hammering



National Gallery of Art, Washington

▲ THIS NINE-INCH Calima style breastplate from the Gold Museum in Bogotá was made from sheet gold, using two processes. The repoussé design around the border and on the H-shaped nose ornament was done free hand from the back while the object was resting on pitch or some other resilient substance. The central mask was pressed from the back into an intaglio mold. It bears no tool marks on the surface but has wrinkles inside the nose and chin, a characteristic of metal that has been pushed into a matrix.

an ingot for awhile to stretch it into a sheet, the metal began to get springy and unworkable. We call this "strain hardening" and now know that it is due to changes in the microstructure of the metal caused by hammering. The Indian worker did not know why, but he observed that his hammer would just bounce off the metal without affecting its shape. If he struck harder blows, it became brittle and cracked. At some stage in his effort to escape from this blind alley, he may have remembered that the metal was pliable when it first came from the fire in ingot form. In any case, he found out that if he heated the strain-hardened

metal, it lost its springiness and hardness and became as easy to work as it had been at the start. True, it would become springy again under hammer blows, but he now knew that the remedy was to heat it. He had discovered the process of annealing.

Hammer-hardening was the "secret process" used by the ancients in both the Old and New World to temper copper and bronze weapons and tools. The craftsman simply refrained from heat-treating the objects after the last hammering. The gold-copper tools found in Colombia were hardened in the same way. In fact, a springy gold ornament like the famous Huarmey

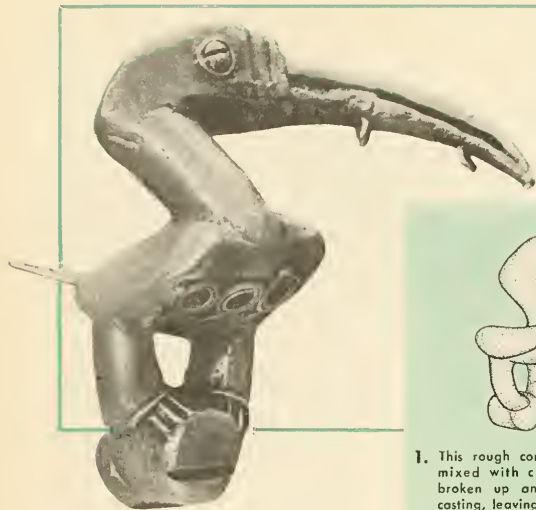
collar in the American Museum of Natural History requires no laboratory examination to establish that, although repeatedly hammered and annealed, the final step was hammering.

The discovery of annealing enabled the smith to "raise" cups and produce other forms previously impossible but it brought him a new

➤ ONE OF THE rare examples of elementary gold art: a nugget crudely shaped by grinding and hammering, from Chiriquí, Panama.

After MacCurdy

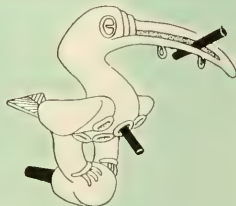




◀ AN EXAMPLE of single-piece casting from the Gold Museum, Bogotá, Colombia. Even the two rings under the bill, which probably supported little gold discs, were part of the single casting as described in the accompanying drawings. It is a Simi-style ornament for a staff, about $2\frac{1}{2}$ inches high.



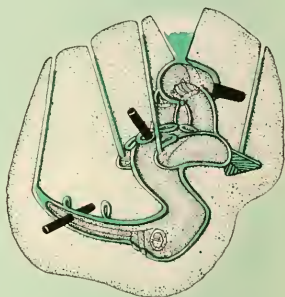
1. This rough core, made of clay mixed with charcoal, will be broken up and removed after casting, leaving the piece hollow inside. This saves gold and also permits the making of hollow vessels.



2. The rough core is first covered with a uniform coating of wax. The eyes, talons, suspension rings under the bill, and decorative holes have been added in the form of wax threads. The founder finishes the details on the wax model with sharp tools. The three black bars are the pegs to keep the core from slipping out of position during the work.



3. The casting will be done in an inverted position. Before enveloping the model in clay, a cane of wax is added to provide a pouring channel. And four wax rods have been added to provide air vents when the metal is poured in.



4. This drawing represents a section through the mold after the wax model has been melted out. The colored portion shows where the gold will flow between the shell and the core. It will rise into the air vents to form rods that will be later cut off and burnished. The core is finally broken and removed through the hollow bill and the holes in the breast and the back of the perch.

crop of headaches. For example, if certain alloys were overheated, they got "burned," and no amount of heat treatment would restore their malleability. All the smith could do was to abandon the work and melt it down. Also, if gold were not watched carefully and removed from the fire when it reached a dull red, it would collapse suddenly. As Herbert Maryon, the British Museum's authority on ancient metalwork, has pointed out, gold gives almost no warning in color change before reaching its melting point. In fact, today gold is often annealed in a dark corner so the craftsman can perceive the subtle change to dull red and withdraw it from the fire.

Annealing ushered in another problem with alloys of copper with silver or gold, which were common in the New World. Heating such alloys in the open air produced a thin scale of copper oxide, which impeded further work and had to be removed. Today this is done by putting the piece in a mild acid bath, or "pickle," while still hot. Spanish chroniclers report that the Indians in Colombia used organic acids from plants.

In discovering how to dissolve the copper-oxide scale, the ancient

workers also found that by alternately heating and "pickling" a gold-copper or silver-copper alloy, they could impart the color of the noble metal to the finished product. This was coloring by concentration, not plating. The repeated action of forming and dissolving the copper oxide without affecting the gold or silver in the alloy left a surface richer in gold or silver each time it was carried out.

The extent to which true plating

was practiced in America before the coming of Europeans still remains to be established by competent metallurgists. Paul Bergsøe has reported some pieces from Ecuador that show signs of fusion gilding, a process in which a molten gold-copper alloy is flowed over preheated copper and then hammered. At one time archeologists here and in Europe unquestioningly accepted the theory that the Indians knew and used mercury for amalgam plat-

ing, a case of relying on familiarity with modern methods to attribute to the Indians a technique they did not possess. That this belief should have gained such a foothold is strange; for in 1653, Father Cobo wrote that, although cinnabar was used as a pigment in Peru, the Incas did not know how to extract mercury from it. And William H. Holmes, writing of the Chiriqui of Panama in 1887, noted that there was "no evidence whatever that these people had any knowledge of mercury." Modern spectroscopic analyses, made by Paul Bergsøe, of ancient American pieces confirm Cobo and Holmes.

Another armchair theory about plating was that models or molds were coated or lined with gold leaf before a casting was poured. But as William C. Root has pointed out, "This is impossible, as the molten metal would dissolve the gold leaf before it solidified."

The high point of hammer work

in raising a vessel from a flat disc of sheet metal was reached by the Peruvian smiths in making high-relief effigy beakers like the one reproduced on page 403. A hypothetical reconstruction of the successive steps from flat disc to finished beaker is presented in the accompanying drawings and captions. The technique was well known in the ancient Near East and Greece and is still used by art metalworkers. It requires that the metal be kept pliable by repeated annealing. It also calls for the greatest skill and care in hammering to avoid cracking or tearing the thin metal. No metalworker today would undertake such a job with the rudimentary equipment of the Indian smiths, and few could do it even with twentieth-century tools.

Two-Piece Molds Used

Once it was found out that solid nuggets could be liquefied by the application of sufficient heat, the

discovery of casting was inevitable. Probably molten metal was first poured into shapes hollowed in the surface of flat stones, or "open molds." Next in order of complexity came the two-piece "closed mold" for ax blades, knives, and the like.

The first step in a two-piece mold was to make a model or pattern to the exact shape of the finished piece. This was pressed into a slab of clay to about half the thickness of the model. A second slab of clay was then laid over the first and pressed down on the model. The two slabs or halves of the mold were then separated and the model removed, leaving a cavity of the same shape. A pouring channel for the metal was hollowed in the mold, which was then fired to harden it. The two halves were bound together, and the molten metal was poured in to fill the cavity.

To avoid having to take the mold apart to remove the original model, some aboriginal genius hit upon the idea of making the model out of wax or resin so it could be melted out. All that was necessary was to leave a hole in the one-piece outer shell or mold. The same hole later served as an entrance channel for the molten metal. When the metal cooled its mold was broken away, and inside was an exact facsimile of the wax model reproduced in solid metal. This was "pickled," sharpened up with tools where necessary, burnished, and polished.

Many persons seem to have gained a mistaken idea of the "lost wax process," as this technique has been called. The phrase has been taken to mean that the *process* was lost and rediscovered, whereas it simply means that the *wax* is lost in the process.

Wax was easy to model, and this process made possible single-piece castings of the most complicated sort. An example is the gold pendant with the twin warriors on page 404. When that object was reproduced recently, the caster took the easy way out; he made it in two parts and soldered them together.

In a mold for a complex shape like the one just mentioned, there



From the Erickson Collection on loan at the American Museum

▲ A SMALL Mexican gold bell with characteristic cast thread decoration.

were many recesses where air would be trapped when the molten metal was poured in, so the caster had to provide for its escape. He therefore attached a series of wax rods around the outside of the original model before enveloping it in the clay. When the wax was melted out, these rods left hollow channels through the outer shell. The molten metal would flow part way into these, leaving tiny bars projecting from the cast object. These were usually cut off and burnished down in finishing the piece, but traces of them in the twin warrior pendant prove that air vents were used in casting this object.

In addition to facilitating the flow of the molten metal by these air vents, it was customary to preheat the mold just before pouring to prevent the metal from cooling and setting before the cavity was filled.

To assure a smooth surface on the finished casting, Sahagún reports that the surface of the wax model was coated with a paste made of water and finely powdered charcoal before the outer shell was applied. Today, an aqueous emulsion of graphite is used for the same purpose in precision industrial castings.

The true culmination of casting from wax models in pre-Columbian America came when this method was elaborated to produce hollow objects. The method was fully de-

scribed by Sahagún in his sixteenth-century account of the Aztec goldworkers. It differs in only one major respect from the method for making solid castings.

The starting point was to make a porous core or nucleus that could be broken up and removed from the object at the end of the process, leaving it hollow inside. According to Sahagún, this was made of clay and crushed charcoal; and analyses of core fragments confirm this.

After the core had dried thoroughly in the sun, it was covered with a coating of wax. The thickness of this wax represented the thickness of the metal in the final hollow casting. Using little pellets and threads of wax for decorative details, the founder completed his model with sharp tools just as a sculptor works in modeling clay.

From this point on, the steps in the process were identical with those described above for making a solid casting. Of course, something had to be done to keep the core from slipping out of position after the wax was melted out and before the metal was poured into the mold to replace it. This was accomplished by piercing the wax model with wooden pegs or thorns, such as magney spines, which penetrated into the core and projected above the surface of the wax. These projecting ends would be embedded in the

outer shell when it was applied and would hold the core in place. A simplified version of the various steps in the process of casting a hollow bird ornament is shown in the drawings on page 406.

Herbert Maryon has suggested that the discovery of soldering probably came when someone first noticed that some nuggets in a crucible melted before others. Having once noted the color and source of these early-melting nuggets, the craftsman was able to procure a naturally alloyed solder merely by separating them out of future lots before anything went into the crucible. Their lower melting point was due to a higher content of silver or copper or both.

Solder in goldwork does not mean the familiar tinsmith's alloy of lead and tin that melts around 330 degrees F. but a series of alloys of gold and copper, with silver sometimes added. These are called "hard solder" by jewelers and have melting points in the neighborhood of 1,500 degrees F.

The joints on many pre-Columbian pieces are so strong and so close in color to the parts joined that there has been speculation about "welding," just as there has been in ancient metalwork in the Old World. The explanation of these perfect joints is to be found in part in the earlier discussion of "color-



▲ **SOLDERING.** The head of this exquisite gold llama was cast from a wax model and soldered to the hollow neck. The rest of the figure is made of ten separate pieces formed from sheet metal and then soldered together.

University of Pennsylvania Museum



▲ **A MEXICAN** ceremonial shield cast in gold from a wax model and decorated with turquoise inlay. The bells hanging from the shield on gold rings were cast individually.



▲ **ELEVEN** repoussé-decorated sheets of heavy gold foil, held together by crimping and gold nails, make up this 5½-inch crouching animal of Calima style, in the Gold Museum, Bogotá.

National Gallery of Art, Washington

ing, or enriching the surface of gold-copper alloys by heating and "pickling." A well-burnished joint on a soldered piece treated this way will be exceedingly difficult to detect. Soil acids have the same effect as pickling on the surface of a gold-copper object buried for centuries. Detection is also made difficult because some of the solder will have penetrated the metal in the parts joined, tending to produce a uniform color.

The pieces illustrated on page 406 show some of the other methods of joining employed by the early workers, such as the use of wires, rings, and crimping.

To summarize, although goldwork that has come down to us shows that the ancient goldworkers of the New World had mastered other techniques, the principal ones were: (1) stretching and shaping by hammering, with the indispensable step of repeated annealing to keep the metal pliable; (2) casting in open and closed molds; and (3) soldering. Of course, many pieces, like the pendant from Colombia on page 402, show the use of combinations of these techniques. In addition, there are the strictly decorative techniques, many of which are also shown in the accompanying illustrations, such as repoussé, chasing, incising or scratching with a sharp point (true engraving requires a steel tool and hence was unknown), inlaying with other metals, setting with precious and semi-precious stones, sheathing wood, bone, shell and resin objects with gold foil, trimming and openwork, and painting metal. Enameling, electroplating, and centrifugal casting are about all we have been able to add.

A final and, unhappily inconclusive, word about the tools of these forgotten jewelers. Not one of their workshops has been excavated scientifically. However, there are examples or reports of clay braziers and crucibles; blowpipes; stone and metal punches and chisels; carved stone and wood models and patterns; stone anvils; and stone and metal hammers. No tongs have been found or described, but unquestionably the ancient workers used some



Dr. Luis E. Valcárcel

▲ ONE OF THE LARGEST and most elaborate pieces of gold work from ancient America: a 17-inch ceremonial knife believed to represent the legendary founder of the Chimu kingdom in Peru. No fewer than six techniques have been used in this piece: casting, soldering, repoussé, stretching, sheathing, and incrustation with turquoise.

sort of lifting sticks to handle hot crucibles and to remove annealed metal from the fire when it reached red heat.

These unknown craftsmen were scarcely the subhuman barbarians many have considered them from the sixteenth century on, nor do they fit the eighteenth century poet's concept of that simple unspoiled child of nature, "the poor Indian, whose

untutor'd mind sees God in clouds, or hears him in the wind." Plenty of free time and patience were not the only advantages these workers enjoyed over their modern counterparts. They possessed an almost matchless dexterity and ingenuity that enabled them to turn out with rudimentary equipment masterpieces that hand workers today would be hard put to imitate.



A Living Luck Charm

Instead of a rabbit's foot, Mayans wear a living beetle symbolic of legend of tragic love

By N. PELHAM WRIGHT

MEXICO, like any country with a great cultural past, is full of fascinating folklore, and any inquiring person willing to rough it in the more remote Indian regions can reap a rich harvest.

The following legend, now rendered into English for the first time, I believe, was gathered by my distinguished friend, the late Dr. Narciso Souza Novelo of Merida.

The reader may have heard of tropical ladies adorning their hair on festive nights with luminous beetles. The theme of this legend is interrelated with that idea in present-day Yucatán. The Mayas traditionally associate another in-

sect both with good luck and eternal life and hold it in a place of affectionate respect in their hearts. The insect is called *Ma'Kech* or *Mácech*, and it is known to scientists as *Megazophorus chileensis*.

In the long, long ago, we are told, in the south of Yucatán, a handsome young prince named Ekcan fell violently in love with Princess Yitz Cään, whose name meant "Dew of Heaven." She was the daughter of a pious cacique named Zac-Lol.

The Prince's father, a neighboring chieftain of warlike disposition, sent a delegation to the cacique to ask for the hand of Dew of Heaven for his son, but the girl's father re-

fused on the grounds that the Princess was destined to become a priestess.

The Prince's father, insulted, decided that his warriors should abduct the girl, but the son intervened in the interests of peace. Preferring to settle his problem himself, he consulted a witch doctress and sent her to Dew of Heaven to tell her that he would come to her secretly at the next full moon. The Princess was now full of anticipation, despite the religious vows that had been taken on her behalf and despite the fact that her quarters were strictly guarded by her father's soldiers.

On the night of the next full moon, the Prince made his presence known to her beneath a huge ceiba tree, close to her house.

The Princess was so passionately in love with the youth that as soon as she saw him, she could not help exclaiming aloud, "Mácech (Thou art a man)!"

The soldiers on guard, who had hunting dogs, heard the Princess say: "My heart and my life are thine," and they surrounded the ceiba tree, Dew of Heaven, fearing that her lover would be killed, fell on her knees and begged for help from the Goddess of the Moon, whose name was U, and then fainted.

On regaining consciousness, she realized that the soldiers had not found her lover. They were completely mystified, for they knew he

continued on page 115



▲ THE AUTHOR has one too. Here it is seen on his hand attached by a silk halter to its home, a piece of bark.



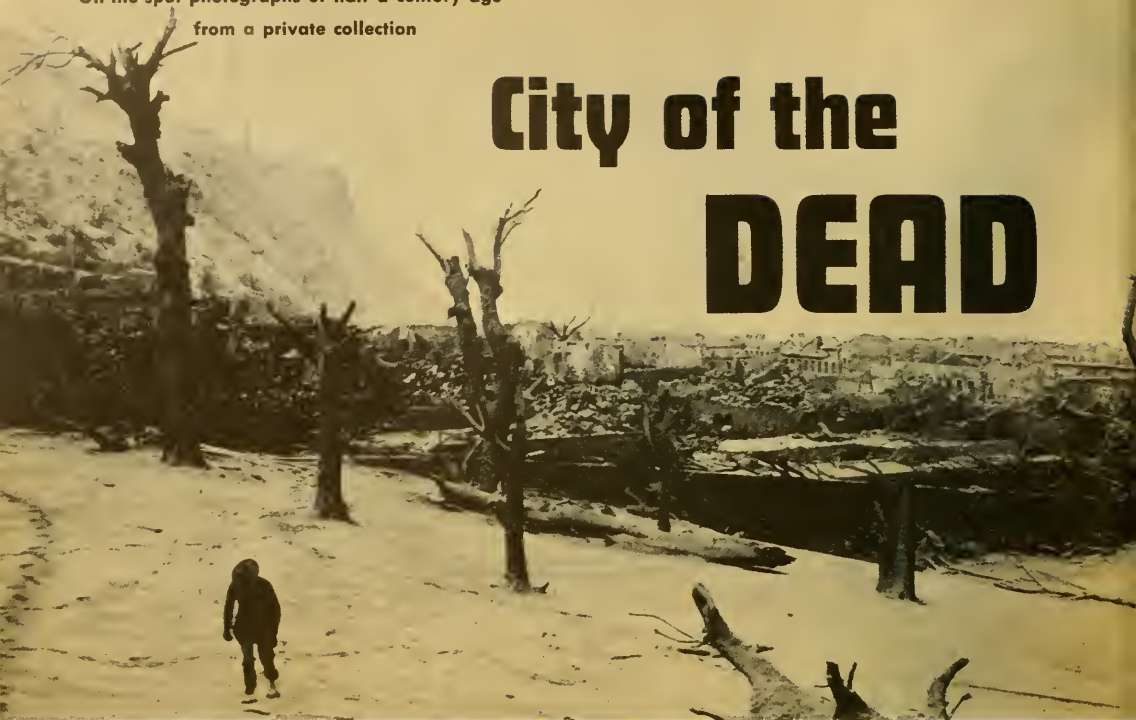
Photo by Wallace Litvin

▲ WHEN A MEXICAN LADY goes out for the evening she doesn't carry a good luck charm, she wears one! At diplomatic functions abroad it serves as an excellent conversation piece.

Published for the first time:

**On-the-spot photographs of half a century ago
from a private collection**

City of the DEAD



▲ THE AUTHOR plodding through the white, talcumlike powder on the outskirts of the ruined city.

One of the worst disasters in history, described by the first man to photograph it

By A. L. KOSTER

Photographs by the author unless otherwise credited

I WAS one of the first to view what had been the bustling city of St. Pierre (pop. 28,000) on the island of Martinique. It was the year 1902, and I had just sailed from the port of Cayenne in French Guiana, where I had helped bury victims of a dreadful yellow fever epidemic. The local priest had been unable to find anyone else, so I had volunteered to help. Coffins being no longer available, we buried 26 bodies in sailcloth. In gratitude, the priest wrote a letter to the Governor of Martinique, suggesting that he show some recognition of my services.

A few days later, on the way to

Martinique, fine powder began drifting down on our decks. It was volcanic ash. Our next port of call, Fort-de-France (capital of Martinique) was tense with excitement and consternation. Twelve miles away, St. Pierre, the principal commercial center, was no more! Volcanic Mont Pelée to the north had again erupted, and this time (unlike the eruptions of 1792 and 1851) it had destroyed completely! All were dead save one, a man in an underground dungeon. Twenty-eight thousand people had been killed instantly.

My emotions on hearing this were mixed, but one thought was

uppermost. I must get to the scene and photograph it. I was told that it was unlikely anyone would be permitted to enter the area so soon after the eruption. There might be another explosion, and in any case, the terrific heat could not have moderated sufficiently to make it safe. Furthermore, I would not be allowed to go alone, and no one



This is the first attempt of the author to chronicle a full, adventurous life spent, for the most part, as a trader in the Pacific.

would want to go with me. My informants did not know that I was an adventurer with an insatiable curiosity, that I owned a brand-new Zeiss camera which had cost me £50 (a large sum in those days), and that I possessed a letter to the Governor requesting that I be shown every courtesy!

I already had had many adventures since shipping out on a freighter fourteen years previously to escape from "Hell's Kitchen" in New York. Among my experiences was a time spent in the copra trade in the South Pacific, and a spell of lucrative pearl fishing that yielded a quart bottle of pearls, which I had just sold for \$30,000.

I approached the Governor with the letter in my hand, and he asked what he could do for me. I made my request: that he facilitate arrangements for me to go to the stricken city. He threw up his hands in dismay.

"That is impossible! No one can go near the place! Who knows when there may be a second eruption?"

I was not to be dissuaded. Reluctantly he placed a steam launch at my disposal but said that it would be up to me to get someone to run it. (It was about twelve miles to St. Pierre.) A spirit of adventure, plus my financial resources, induced the engineer of the launch to accompany me. Two attendants at the hotel were similarly persuaded.

The scene that met our eyes as we approached the devastated city was indescribably awful. I shall never forget it. A prosperous, thriving city of 28,000 people had been leveled to the ground. No signs of life were visible. As we came closer, complete silence confirmed this impression.

Once ashore, we found the ground covered with the finest kind of whitish powder, like talcum powder. In some places this had drifted to a depth of a few inches, but for the most part it was a thin layer, and the ground was even bare in spots.

I have since read scientific hypotheses as to the possible source

of this fine powder, but to this day none have convinced me. Buildings had fallen in, even those with stout stone walls were toppled. Yet strangely there was no lava, such as buried the city of Pompeii when Vesuvius erupted. We asked ourselves how such damage could have been inflicted without substantial evidence of the cause.

Evidence of terrific heat was everywhere. The bodies of victims strewn among the ruins were greatly reduced in size. It was as if most of the moisture had suddenly been extracted from them. But as they were not burned, and as trees and other pieces of wood were barely charred, I concluded that either the duration of the heat



Lone Survivor

THE PRISONER who alone survived the blast was found in an underground cell of the city jail.

Benoit-Jeannette



Before...

THE CITY OF ST. PIERRE, Martinique, before and after the eruption of Mont Pelée. In a matter of minutes, clouds of incandescent and explosive gas obliterated the city and killed all but one inhabitant.

...and after





▲ IT LOOKED as if a light snowfall had dusted the tropical hills near St. Pierre. Actually, when this picture was taken, the ground was almost too hot to walk on.



◀ NO PORTION OF THE CITY was left standing, and the bodies of thousands could never be recovered from the rubble.



had been extremely brief or that the heat had failed to ignite anything because of an absence of oxygen.

What I saw was consistent with the theory that an incandescent cloud had come pouring down the side of Mont Pelée, setting off explosions as it progressed. But why should a mass of incandescent gases flow downward instead of rising? (Similar clouds, though smaller, have since been observed coming down the side of Mont Pelée.)

I immediately started taking pictures. It was extremely difficult. My 1902-vintage Zeiss camera was a single-load affair using glass plates and mounted on a heavy tripod. To make matters worse, the ground was so hot that it was no simple matter to hotfoot it around from one location to another while changing plates at the same time. However, I did manage to take

more than 50 exposures, some of which are reproduced on these pages.

Immediately outside of town the grass was green. The destruction was so narrowly limited to areas of human habitation that the thought of Divine Retribution came to mind.

The destruction was not limited to St. Pierre. A tidal wave attending the blast drove sailing vessels ashore. Their masts had shrunk to a mere fraction of their original diameter inside the protective iron collars at deck level. The commander of the U. S. naval vessel *Nebraska*, at anchor in the harbor, told me that no life existed aboard a freighter smoldering in the distance. A cargo of flour was apparently the cause of the smoke or steam that still rose from her hold.

Although half a century has passed, my memory of that day in May, 1902, does not have to be

jogged by the accompanying photographs. I shall never forget that glimpse of one of the worst disasters in history.

I have recently learned that the prisoner who escaped death because he was in an underground dungeon was not, contrary to popular belief, a convicted murderer but a man who had been placed in prison for one month because he had wounded a comrade. His miraculous survival led P. T. Barnum to exhibit him as one of his curiosities in the United States.

St. Pierre was only partly rebuilt. Today its remaining ruins are partly covered by the ashes of subsequent eruptions. The last was in 1929. The ruins and a volcano museum are a tourist attraction, a source of income to some of the 5,000 inhabitants of a new town nearby, also called St. Pierre. The old city of St. Pierre is still, for the most part, a city of the dead.



▲ TREES WERE SHATTERED, but the intense heat failed to burn them, either because it passed so quickly or because lack of oxygen smothered any fire.



▲ EXPLORING THE RUINS: two of the attendants from the hotel in Fort-de-France whom Mr. Koster induced to step ashore in the city.

▼ SMOKE OR STEAM was still rising from the stricken city when the author landed.



▼ HEAVY STONE WALLS were toppled.



▼ A HULK gutted by the cataclysm, probably a ship named the *Roraima*. In the distance at right is the U.S. naval ship *Nebraska*.





Flower for a Queen



▲ QUEEN CHARLOTTE, youngest daughter of the Duke of Mecklenburg-Strelitz, for whom Sir Joseph Banks named the flower *Strelitzia reginae*.

A rainstorm,
a letter,
and
a teakettle
write a romantic
page of history
for the exotic
Bird of Paradise flower

By ELINOR WALLACE HIATT
Photographs by JULIAN HIATT

THAT one of the most excitingly beautiful of all flowers should be named for a plain, quiet woman is both unusual and surprising. And only in the pages of a storybook would a girl in a nunnery be asked to marry the king of the world's most powerful nation. But when both of these unusual events happen to the same girl, then we have a truly romantic tale.

The lady lived no further back than our own early history. She was Charlotte Sophia, Queen of England and wife of George III. The flower is the spectacular Bird of Paradise.

Three circumstances combined strangely to unite the exotic flower and the Queen: a letter, a rainstorm, and a curate's scientific interest in tea kettles.

Charlotte was the youngest daughter of Charles Lewis, Duke of Mecklenburg-Strelitz, a tiny German province on the Baltic Sea.



▲ THE BIRD OF PARADISE FLOWER has larger relatives, but none match the vivid gold and blue of its flower.

Duke Charles died shortly after Charlotte's birth, and she was brought up by her mother. The family was not a wealthy one. Charlotte lived for some time in a Protestant convent and expected to devote her life to this order. But a letter intervened.

A regiment of Prussian troops quartered on family territory had been misbehaving in such outrageous fashion that people roundabout were shocked. Charlotte, then in her teens, was the only one to act. She wrote a letter to Frederick the Great, King of Prussia, begging him to regulate and restrain the soldiers. The King was impressed with the sincerity and dignity of her letter and showed it to several of his

friends, one of whom sent it to England. This letter released Charlotte from her nunnery.

George III came to the throne when he was only twenty-two. Not for many reigns had a king been faced with such bright prospects. Unlike his Hanoverian predecessors, he had been born in England and was thoroughly English in language and tastes. He was handsome, honest, and honorable. Completely blocking his path, however, were two devoted, foolish, but powerful persons—his mother and his chief favorite, Lord Bute.

His mother, Augusta of Saxegotha, Princess of Wales, was a domineering woman with passionate likes and dislikes. For years, she had anticipated her glory as Queen of England; but the death of her husband, Prince Frederick, ended her cherished hopes. She immediately directed all her efforts toward shaping the kingly future of

her son. She succeeded only too well in bending the boy to her will.

As soon as the King's mother saw this letter from the little German princess, she inquired into the girl's background. She was pleased by what she learned of Charlotte's common sense, her wholesome practicality, and her healthy moral upbringing. The young King had already fallen deeply in love with Lady Sarah Lennox and hoped to marry her. However, his mother controlled him so completely that he agreed to her choice and dispatched a suitable naval escort to bring Charlotte Sophia to England.

On September 7, 1761, the little fleet reached England. The next day at St. James's, the Princess of Strelitz was presented to the King of England and the waiting court.

She was a frightened child, alone in a strange land. It was not only her first appearance before the English court; it was her wedding day. So she went from her stagecoach to the unpacking of her wardrobe boxes. She chose to be bravely regal in a mantle of violet velvet trimmed with ermine, a sumptuous stomacher, and a modest diamond tiara. The coronation portrait by Allan Ramsey, which hangs in the National Portrait Gallery, shows her eager happiness. Robed in royal splendor, she stands with fingertips resting lightly upon her crown, a shy, eager smile on her face as she looks confidently into the future.

Years later Charlotte said that, from her wedding to the long period of the King's insanity, she had never a moment of real sorrow. Young though she was — only seventeen when she became Queen — she possessed all the qualities that a royal husband might want. She once told Fanny Burney, her lady-in-waiting, how excited she had been at first: to step from the bareness of her convent life, with its rigid rules, inflexible economies, and stark simplicity of costume, to the purple, the ermine, and the cloth-of-gold that would befit a great Queen; to dip her slender fingers into the cool fire of the rubies and the emeralds that belonged to the British Crown. But

THE AUTHOR has had years of experience in teaching college courses in the writing of biographies. Added to this, even more years of plant study, including extensive library research, have provided her with a background for writing this article.—ED.



▲ SOUTH AFRICA is the homeland of the Bird of Paradise flower. It is a member of the banana family.

these joys, she said, were childish and passed in a few days, while her frugality remained.

She was placidly content. For her, no affairs of state existed; she ventured no opinions on problems of government. She asked no questions, expected no information, desired to exert no influence. Her England was encompassed within the buildings and the grounds of the royal residences.

Farmer George

The gardens of the palace gave the Queen and the King exceptional delight. Charlotte was intensely interested in flowers. But with the King, plant growth was a passion. Since he thought of himself as a simple country squire, most of his happy hours, which were all too few, were spent as Farmer George, puttering around, planting flowers and vegetables, and overseeing the gardens. He even wrote articles on horticulture, signing the name "Ralph Robinson" to the pages on turnip-raising that he wrote for *Young's Annals of Agriculture*.

He came naturally by his botanical interests, which were perhaps the one good aspect of the life his mother and Lord Bute had shaped for him.

Lord Bute's introduction to the royal family occurred during the rainstorm mentioned earlier. In 1747, when the Princess of Strelitz



was only three, it rained at the Eggham races. The Prince of Wales, we are told, had been ready to go home, but he hesitated to step from the royal canopy into the downpour. He would wait, but he must have amusement. Cards could fill the time, but there was no fourth hand. Lord Bute, along with all other hangers-on of British nobility, was at the track and was also delaying his departure. Recognized by someone in the royal tent, he was summoned to join the Prince of Wales in a game of whist. The charm he well knew how to display delighted the Prince.

It was not long before Lord Bute had become the leader of the frivolous set that eddied about the heir-apparent. The death of the Prince in 1751 increased Bute's influence. The Princess consulted him constantly on household matters. At every turn she sought advice in molding the mind of her son. And when the King married, Lord Bute supplied the Princess-mother with a new enthusiasm for her tremendous energy. He suggested that she expand her husband's grounds into a true botanical garden with a collection of plants gathered from all quarters of the globe. The Princess and her husband had lived for years at Kew. Here Augusta retired after the arrival of Charlotte, and here she renewed her early interest in plants.

British Information Services



It was now time for the entrance of the clergyman with the tea kettle. Stephen Hales was perpetual curate in a small parish near Kew. A youthful interest in plants and experimental chemistry fitted him to become a Fellow of the Royal Society. Now, in his old age, he pattered around his laboratory.

When the Princess of Wales first knew Curate Stephen Hales, he was busily investigating the inside surfaces of the tea kettles of the neighborhood. If the kettles were heavily encrusted, he drew certain conclusions as to the desirability of the water for plant irrigation and other domestic uses. This theory had delighted the Prince and the Princess. When Augusta retired to Kew, she asked Hales to help her in her botanical garden.

The "Great Stove"

His most lasting project was to design the flues for heating the Great Stove. For Augusta had wholeheartedly followed Lord Bute's suggestion to collect and import foreign plants. The King, always eager to share any botanical enterprise, had appointed a very capable director of the gardens at Kew, Sir Joseph Banks, probably the most able botanist of his time. He was as enthusiastic as were the Princess and the King at the idea of plant exploration, and he went on several extended voyages. He also dispatched trained collectors to cull the world for choice specimens. One of his particular interests was South Africa. To protect the tender plants from such localities during the severe British winters, extensive heating apparatus was required. No wonder it was called the Great Stove, since the first plans called for a length of 300 feet. When completed, the Stove afforded protection for the exotic plant beauties from abroad.

The most beautiful plant of the hundreds established by Banks was a startlingly brilliant member of the

banana family, the flower that we know as the Bird of Paradise. In 1773 it was brought from the Cape of Good Hope and settled at Kew, safeguarded by Hales's stove. Banks studied this plant until he knew its every line and color. Then, after the manner of chivalry, he dedicated the flower to the Queen who had come from the duchy of Mecklenburg-Strelitz to become a bride of seventeen. He called the plant *Strelitzia reginae*, and thus it has been known down to our time.

How the Queen must have enjoyed the drama of the flower's opening: the first appearance of the yellow point from the enclosing sheath, the emergence of the golden wings, then the wonderful, vivid blue, until the "bird" stood poised above the boatlike casing as if for flight.

Later a taller variety was brought from the Cape, a plant that reaches a height of twelve feet or more. The flowers are much larger than those of *reginae* but much less brilliant in coloring. The flaming yellow is replaced by dull white, and the blue is darkened almost to black. This plant, also established at Kew, was named *Strelitzia augusta*.

Today we give the Bird of Paradise, the Queen's strelitzia, a cherished place in our gardens. We do not often see *augusta*, for if we have space enough for the majesty of the larger plant, we choose a newer discovery that is even taller than *augusta*, the *Strelitzia nicolai*, the traveler's palm, which sometimes reaches eighteen feet. It was, perhaps, this plant of which A. F. Gardiner spoke, when in recounting his travels through the Zulu country, he remarks, "We slept well under the shade of some strelitzia trees."

The Bird of Paradise still grows at Kew. Hales's stove was used long after the death of the Queen, but in 1861 it was replaced by a more modern heating apparatus. The flowers it protects are wondrous, so if ever you visit England, you may enjoy having a look at them, in the Royal Botanical Gardens at Kew, just west of London on the Thames.

◀ A GLIMPSE of a favorite tourist attraction near London. The famous Royal Botanical Gardens at Kew.

Want to be a PARK RANGER?

In answer to inquiries from our readers regarding jobs in the National Park Service, a Park Ranger's wife tries to help you decide if this is the life for you

By RUTH KIRK

Photographs by LOUIE KIRK

WOULD you like to range over the United States from desert valley to mountaintop, earning your living by helping park visitors and by such chores as packing supplies by horseback to fire look-outs, guarding wildlife against poachers, planting fish, and digging ditches? It isn't every job that can take you from Death Valley to Paradise, but that is what has happened to us in the National Park

Service. My husband's job as Park Ranger has taken us from Death Valley, where we plotted the trails of "moving rocks," to Mount Rainier, where we crawled after ice worms in the caves under Paradise Glacier.

In the seven years we have been in the National Park Service I have found that it is more than a job; it is a way of life, an outdoor life, for the entire family. It has meant

isolation at times, and playing host to thousands at other times. At Death Valley, it was 100 miles to a shopping center; and at Organ Pipe Cactus National Monument, in Arizona, it meant teaching my two boys at home. It also has meant living in extremes of climate—from the hottest and lowest desert to one of our highest mountains amid extensive glaciers.

It has meant variety: calling the

▼ LIVING BEYOND the reach of movies and television keeps amusements like reading aloud very much a part of ranger family life.



★ ONCE when the author's husband, a District Ranger, stepped out of the office, Sniffles, the tame deer, helped himself to the half-finished office forms.



▲ THE AUTHOR'S HUSBAND making a winter patrol in Mt. Rainier National Park. The Ranger's life sometimes brings extremes of heat and cold, as well as of crowds and solitude.

children in from the yard when buffalo grazed our lawn, and the evening task of going through the house squashing scorpions. I have had movie stars on location as my dinner guests, a murderer on his way to jail, and U.C.L.A. professors who slept on the living room floor when they got rained out of a botanical survey.

According to the Park Service's official description of the work, a Park Ranger's duties consist of public relations, fire fighting, conservation, law enforcement, maintenance and construction, road and trail patrol, fish and wildlife work, and lecturing. A Ranger is expected to be a jack-of-all-trades — and should be expert in most! He is expected to repair everything from the elec-

tric power system to plumbing, from radios to trucks. He builds cabins, lays out campgrounds, grades roads, identifies birds and wild flowers, and is asked such questions as "What happened here during the Jurassic period of the Mesozoic era?"

Varied Duties

A Ranger must be capable of properly handling, without immediate outside assistance or guidance, any problem that could conceivably occur in a remote and primitive area, says the official announcement. One can't take care of 50 million Americans on vacation, mile after mile of primitive country, and assorted wild animals without learning how to deal with the un-

expected! A Ranger must know how to dissuade an irate husband from throwing stones at his wife in a campground, must be ready to help stranded motorists out of sand dunes and snowbanks, and can be called upon to extract fish-hooks from girls' fingers or hair, and even to set broken legs.

There is desk work to be done, too. The administrative side of the job includes filling out innumerable government forms, writing reports, and co-ordinating park activities. But even such a seemingly routine matter as filling out forms can be complicated by the presence of another responsibility of a Ranger—"tame" wild animals.

"Sniffles" was a deer who liked to drink from a fountain instead of



▲ **SNIFFLES** preferred humans to deer and joined the Kirk family. Here he is ready to finish a letter if Mrs. Kirk doesn't.



▲ **NO CHRISTMAS TREES** grow in Organ Pipe National Monument, but true to the Park Service's tradition of resourcefulness, the Kirks made good use of what was available.

➤ **PET OF THE POST:** "Horny," a horned toad, being fed by one of the Kirk youngsters. The only time it was grumpy and nervous was once after hibernating from December to mid-March.

the river. He was so fond of humans that the only way snow-plow drivers could get their work done was to take him in the cab with them. One day he insisted on climbing aboard the school bus with the children!

But the day we really wished Sniffles would go back into the woods where he belonged was when he decided to help my husband with the remittance forms of vehicle-entry fees. The forms were almost completed when my husband was called out of the office to talk with a park visitor. When he returned, he found that Sniffles had finished them for him. He had eaten them all—white, pink, green, and blue copies!

A Ranger also must know where the fly-fisherman can catch twelve-inch rainbow trout, where the wild-life photographer can find a band of mountain goats, and the best



canyon in which a botanist can study life-zones. It was when a Death Valley downpour ruined a life-zone study that we had the professors from U.C.L.A. sleeping on our living room floor.

There are other aspects of the job to be considered, too. As pointed out by the editor of *National Parks Magazine*¹, "The Park Service is so short on manpower, that rangers trained to assist visitors enjoy the parks must sometimes serve as traffic cops in parking areas or keep washrooms clean."

The versatile Ranger must also

be a quick-change artist. I recall one afternoon in Death Valley when my husband had to repair a sewer line. A woman camper was quite willing to give advice from the sidelines. Later that day, he changed into his uniform to deliver an illustrated lecture, and on the way back he stopped at the still-open ditch to inspect his work. The woman didn't recognize him. "Everything's okay now, isn't it?" she volunteered. "The young man they sent to fix it seemed to know what he was doing."

In establishing the National Park Service 40 years ago this August, Congress stipulated that

¹*Exploring Our National Parks and Monuments*, by Devereux Butcher. Boston: Houghton, Mifflin, 1954.



▲ THE KIRK'S ASSIGNMENT in Death Valley familiarized them with the lowest and hottest desert in the country.

its purpose would be to "promote and regulate" the public use of the areas in its charge in such a way as to "conserve the scenery and the natural and historic objects and the wildlife therein, and to provide for enjoyment of same." Today there are 182 areas (38,540 square miles) under National Park Service administration. These areas include national parks and monuments, historical parks, parkways, memorials, battlefields, cemeteries, recreational areas, and the parks of the National Capitol. The entire scope of our American heritage is represented—scenic, scientific, historic, and pre-historic.

Another interesting job in the National Park Service is that of Naturalist, a position often filled from the Ranger force as vacancies occur. The work consists of public relations, lectures, guided hikes and motor trips, museum interpretation, museum display preparation, research, and photography.

Summertime Jobs

A limited number of summertime jobs are also available. For employment as seasonal Park Rangers, the Park Service especially wants college students who are at least twenty-one years of age and have completed at least three years of

college. Fire control aids and unskilled laborers are also wanted, for which the minimum age requirement is eighteen years.

Most women employed by the Park Service are in clerical positions; this is true of both permanent and seasonal openings.

An applicant for one of the limited number of yearly openings for permanent Park Rangers must have had three years of progressive experience in park work on the managerial side, or experience in a technical field such as forestry, wildlife management, or geology — or he must hold a college degree with major courses in forestry, biology,



Park Rangers must adapt to sudden change. The Kirks were lifted from the depths of Death Valley (below) to the heights of Mt. Rainier (14,408 ft.). This transfer enabled Ruth Kirk (above) to ski at Paradise, Mt. Rainier, after several sizzling seasons in Death Valley.



conservation, physical geography, geology, or wildlife management.

Application for both permanent and seasonal jobs can be made on Form 57 obtainable at any Post Office.² For permanent positions, one must take a stiff Civil Service examination. Notice of pending examinations is posted in Post Offices, or qualified applicants may be notified of the time and the place most convenient to where they live.

What is the Pay?

A Park Ranger starts at \$3,670 a year (General Schedule, Grade 5). He can work up through Supervisory Park Ranger, District Ranger, Assistant Chief Ranger, Chief Ranger, and Assistant Superintendent, to the post of Superintendent or Regional Director. From there, or anywhere along the line, he may switch to a responsible post in one of the five regional offices in San Francisco, Santa Fe, Omaha, Richmond, and Philadelphia, or the

²Send completed forms to the Personnel Officer, National Park Service, Dept. of the Interior, Washington 25, D. C.

national office in Washington, D.C. A Superintendent's salary ranges all the way from \$5,440 to \$12,690.

The pay scale for Naturalists is similar to that for the Ranger job.

Park Service employees enjoy all the advantages of Civil Service employment: job security and such benefits as insurance and participation in the federal retirement plan. In most field areas, housing is provided at a nominal rent.

This year over 50 million people are expected to visit the national parks and other areas administered by the Park Service. By 1966, when the Park Service will celebrate its golden anniversary, the figure is expected to reach the 80-million mark!

In order to cope with this influx of visitors a long-range plan called Mission 66 has been worked out. President Eisenhower has recom-

mended that Congress adopt it; and of the plan itself, Conrad L. Wirth, Director of the National Park Service, has said, "Our objective is to give the American people on this golden anniversary a park system adequate in all ways necessary for their enjoyment and inspiration."

What will this plan do? It calls for more ranger services such as lectures and guided tours, more museums, exhibits, and visitor centers, improvements in the road and trail systems, more campgrounds, and the stimulation of private capital to provide overnight accommodations.

The implementation of Mission 66 will also mean increasing opportunities for those wishing to enter the Park Service. Perhaps this is the job opportunity *you* have been waiting for!



◀ THE KIRK FAMILY tobogganing in the wonderland of Mt. Rainier.

▼ PARADISE INN, still blanketed by 20 feet of snow in late April.



Letter from Nepal

An intimate glimpse of the Gurkhas and their mountains,
through the eyes of an intrepid woman traveler

By DIANE LEC. RAWSON



▲ NEPALESE WOMEN, encountered by the author south of Kathmandu. The improvised headgear is so fashioned as to ward off the sun's rays.

M Y fundamental mistake was to say, "Yes" when a British Gurkha officer asked me to join him in an expedition over the Himalayas to the Tibetan border. I leaped at the opportunity, for my purpose on this extended journey was to study conditions at many points along the Communist frontier, all the way from the Caspian Sea to the Pacific. But I should have given some thought to the toughness of the mountains, to the fact that my companion was a Gurkha officer accustomed to long marches and difficult terrain—and knew his capacity for both. As a military man he would also set himself a definite schedule from which he would not deviate.

I was coming straight from the valley where temperatures were hitting the 110 mark and where in terms of long marches, four miles a day on relatively level ground had been my maximum.

Then there were those magnificent yet terrible mountains. A few days before leaving Kathmandu I had spoken to a man who had climbed them, and he had said, "Those mountains are killers!"—with emphasis on the word "killers."

It was barely daybreak when we started our march, accompanied by a Sherpa and four porters. We drove to the end of the valley, and there it was—the mountain like a wall rising straight up in front of us. I wondered where the trail was and heard my companion voice the same question. Well, there was no trail then, and there were no trails later either. One went up deep grooves formed by the down pour of rain and avalanches.

For four hours we climbed in a straight, perpendicular line. Stones rolled from under our feet, and again and again what looked like firm earth simply disintegrated. There were places where you had to squeeze between rocks and others where you had to pull yourself up by roots—but the roots I grabbed invariably decided to follow me!

I began to shed one piece of clothing after another. Soon I was down to a pair of khaki trousers and a light blouse, but sweat continued to pour down my face, my hair, my back, my legs. Fortunately I could not see myself, but I must have looked like a duck straight out of the water. Then I was conscious that my companion was nowhere in sight. While my eyes had been glued upon each step I took, he had earned on like a soldier.

The Sherpa was a sturdy fellow with a shiny brown face. The wrinkles around his eyes opened like a fan each time he smiled. When I looked, he also had vanished, but then it was his job to lead the way! With me still were all the porters—their steps were as slow as mine because of their loads of 80 or 85 pounds. Then I noticed that one *was* missing, the most important one, the one who carried all the food and water on his back!

It is hard to describe the strain of those 14 miles of climbing over two major ranges of mountains without food and water. Finally at 4:30 that afternoon, feeling more dead than alive, I stumbled into our first camp. To finish it all, or rather finish me, when I pushed the door that led to our sleeping quarters, it came off whatever was holding it up and simply pinned me against the wall. Had I had a softer skull, I would not be telling the tale now, perhaps. But it only made me more numb to



▲ AGRICULTURE is accomplished by back-breaking work in terraced fields with primitive implements such as the hoes used by these women.



▲ YOUNG AND OLD ALIKE have to work hard in this part of the world. Here two Nepalese porters rest against their well-filled baskets.



Belgian by birth, American through marriage, the author has turned a liking for travel and meeting people into a writing career since the death of her husband.



▲ POKHA, THE YOUNG PORTER who also had to serve as guide. On the trail the basket on his back is carried by securing the strap over the forehead. This frees the hands for climbing.

the world than I was, and soon I was sound asleep.

When I awoke, I thought the house was on fire, but it was only our Sherpa, Sonham, preparing a dinner of chicken and rice. Nepalese houses have no chimneys, and windows are often bolted. Thus one inhales smoke day and night!

That night I felt more like crawling than walking, but my British companion insisted on a visit to the "local pub." We sat on the floor and drank "chang"—a local beer or wine, made out of rice and as thick as porridge. All sorts of strange things were floating in it, so a young maid plunged her hand into the mixture, gathered them all, and negligently tossed them over her shoulder. Then, we drank it down. In my state of exhaustion I suddenly felt as if I were growing gigantic wings.

On the following days, the mountains grew in size and the "paths" became increasingly more impossible. My companion did not believe in breakfast; he started the day with only a cup of tea or chocolate, and then resumed his forceful march. For me it amounted to a forced march, and I slowly began to dissolve from lack of food and water, and a climb far beyond the strength of my two legs.

My mind still refused to give up but my body was gradually developing a will of its own. It wanted to curl up somewhere and be left alone. It refused to be dragged by my mind any longer, and I was forced to admit defeat. Never have I experienced such extreme fatigue, but I know now that it is the weirdest and most terrible feeling imaginable.

When I announced my intention my companion understood. "I suppose the trek is a bit tough," he remarked in a classic understatement, "and that 16,000-foot mountain ahead is a difficult pass." Then he added, "Take one porter, and here is some food, but you will have to depend for most of it on the villagers."

From that time on, Pokha (my porter) and I were on our own. I felt crushed not to be able to con-

tinue the trek towards Tibet, but had I forced myself to do so, I fear I would have soon been walking in a twilight world.

Pokha was a wonderful companion, and he took his added responsibility as guide very seriously. The whole afternoon we climbed and climbed some more. Then rain began to fall, and when it became dark we were forced to seek shelter for the night.

A Bedraggled Quest

There was a small stone house on the edge of a precipitous mountain wall—beyond were only more mountain ranges, low clouds and more rain. While Pokha spoke to the old couple who lived there, I stood on the threshold dripping from head to toe. I must have presented a frightful sight, because a while back I had rolled down an embankment of red mud, and now the mud dripping down my arms and back made me look like a zebra.

Immediately the old woman offered me her bed—a wooden plank covered by an old straw mat—and retired to a corner of the room near the fire. I told her the floor was good enough for me, but she refused to budge from her new position. I wondered how I could possibly repay their hospitality for we had little food—a small quantity of rice, some onions, and a jar of jam. And what earthly use was jam with nothing to put it on? Then I remembered the tea. I suggested that we all share it and since they were too poor to buy tea, this represented a great feast. Quickly Tibetan tea bowls were pulled out of dark corners (those lovely silver and smooth wood ones, of the type I had known in Inner Tibet), were dusted off with the old woman's skirt, and we settled down to wait for the water to boil.

Meanwhile Pokha was worried that I would not eat. He carefully wiped my fork and plate with an old greasy rag which he retrieved from the bottom of his basket, and even more fastidiously rinsed the rice in some water—with a hand soiled by a day's march! But all I

wanted was water—it was becoming an obsession—but since none was forthcoming for drinking, my mouth was now watering for tea.

Many questions were asked about me, and Pokha told and retold the story of what had happened. Then he would add that I was now on my way back to Nepal. At first I thought this was an odd remark to make, but later I learned that this was the way the Gurkhas spoke of the valley of Kathmandu—a world totally separate from their own. They seemed genuinely sorry for my failing to reach my objective and anxious to be of help.

There was still some daylight when I fell asleep. During the night I awoke to find that it was still raining and that water was dripping through a hole over my head. My clothes felt clammy; they had stubbornly refused to dry. The old man must have heard me stir because I saw his shadow quietly creep towards the fire, and he put another stick on it.

It was hard to breathe in the room because it was hermetically closed and now the fire once more was belching smoke. But I did not care for it was only this feeble warmth that kept me from shivering. Now for the first time I understood why the people lived this way. Though the houses were solidly built of stone, in winter vicious winds and high altitudes must have made them frigid. And their clothes! Like me now, they must also be soaked through and through, and what other clothes had they to put on?

This house, as I was to learn later, was in many ways typical of Gurkha



▲ THIS YOUNG COUPLE belongs to the Tamang tribe of the Gurkhas. While the wife, wearing the usual complement of jewelry, seems to look askance at the author's picture taking, the man of the family is taking it in his stride.





▲ TWO YOUNG NEPALESE porters against a backdrop of the Himalayas. Terraced fields are just visible in the middle distance.



▼ UMBRELLA-HIMALAYAN STYLE. A young porter protects himself on a rainy day in the mountains.

houses. It was devoid of furniture for the possessions of the people were meager.

Smoking seemed to be their only luxury: men, women, and even children were avid smokers. Whether it was water pipes or cigarettes, always these were shared.

They observed an odd Eastern custom. Neither pipes nor cigarettes ever touched their lips. One clenched one's hand into a fist, and the cigarette was then placed in the curled-up little finger. The next move was to apply the mouth at the other end of the fist and draw a deep breath.

With the first rays of light, the people were up. After a few monthfuls of cold rice, they were ready to start another day—each one with his basket on his back filled to the brim, secured by a leather strap over the forehead. I would have thought that the weight would have crushed their foreheads, but whatever it did to them, both young and old, it never spoiled their cheerful dispositions.

Within a few minutes we were on our way. The sky was suddenly brushed of its clouds and a whole range of snow mountains was before

us. In places where the rocks gave space enough, teak trees, rhododendrons, wild orchids, and delicate spring flowers were visible. I was elated for now there was hope that we would be able to reach Malenchu, an old Sherpa town. Barely had this thought crossed my mind before heavy clouds raced across the face of the nearest mountain and again it began to rain.

The following days were ones of frustration. The monsoon which should not have reached the Himalayas for another month was upon us, and I was told that my last chance of reaching Malenchu was gone. Even the wash-out gullies that had served as trails had melted away.

Cheerful Hosts

The hospitality of the people living in scattered farmhouses never varied. If the family was large and the floor space small, they slept in tighter formation to give Pokha and me sufficient space on the mud floor to stretch out our tired bodies. If the sun was still high in the sky when Pokha cooked our rice, I would make a supreme effort to keep awake and watch the people, for

they were the best antidote for my state of exhaustion. They were such a cheerful, brave lot—day after day, up and down these cruel, oblique slopes we had passed men, women, and children, even old men, carrying the most staggering loads on their backs. Yet, though sweat often poured down their faces, and many were panting, they were quick with a smile. Many also sang as they climbed, and you could hear their voices from far away.

The people throughout this whole region belonged to one of the major tribes of Gurkhas, the Tamang. Like all Gurkhas, they were a sturdy lot. I liked their eyes: they always looked straight into yours with a warm curiosity. Many of the women were pretty, and in a group they were always lively.

At one house where we were forced once more to seek shelter from the rain, I was stripped by the women of hood, jacket, and shoes so that they could be put over the fire to dry. Today, to recall those hours among the Gurkhas, all I need to do is to close my eyes and lay my head upon the old jacket, for the smell of smoke, I know, will never leave it.

▼ A GURKHA who doesn't share his pipe; he smokes it in the conventional way!



▲ MANY Gurkha women are as attractive and pleasant to behold as this one, whose flashing smile competes with her gold locket-necklace.

But now, all our reserves were exhausted and it was difficult to get sufficient food in the villages—or rather the few houses scattered about the mountain sides—for the people seldom have even enough food for themselves. In one place we were able to buy three eggs, and it was a major operation to explain to Pokha how to hard-boil them. But I finally succeeded and from then on, providing we were able to buy eggs, this was our steady diet.

But my thirst increased as the days went by, and our supply of tea had been consumed that night at the house of the old couple. Water was available at the farmhouses but was unusable because most of the water drains ran close to piles of manure. Also there was the danger of what was known as "hill dysentery," contracted because of an accumulation of mica in the water, which could only be eliminated by fine filtering.

It was then that I thought of milk. For a moment I could not remember the Nepalese word for it, but quickly I drew a cow with all the necessary details, and Pokha began to cover every house in sight. But many farmers hadn't any cows and those who had some milk could not afford

to sell it to us, for barter here is more profitable than money, and milk is a good barter item.

Overexertion, no liquid, and a meager diet leads to an extraordinary state of affairs. One slowly becomes weaker and the spirit takes a plunge. I think the only thing that kept mine alive was the people around me. They took me in as if I had always been their friend. They had so much energy that it was an inspiration to watch them working together.

Way of Life

Here there was no segregation: men, women, and children worked together, played together, ate together, smoked together. There were free exchanges of conversation always, and laughter between men and women. You could tell that they enjoyed each other's company. Now I could understand the many stories I had heard about Gurkha soldiers. They had learned how to be self-reliant in their harsh mountains where they had had to overcome obstacles daily. They had learned this when they were very small. As they had grown up, they had also learned that to maintain their iso-

lated independence they would have to team their strength and capabilities.

More than once I was reminded of their Code, a simple but definite one which appealed to man's sense of honor and honesty. "Thou shall not kill man . . . thou shall not tell a lie . . . thou shall put aside of all thou eatest for the aged and infirm" read parts of it. The section devoted to women declared "thou shall not praise thy neighbor's wife above thine own . . . nor commit abortion." It is also here that one learns that women could divorce their husbands by placing two betel nuts under the conjugal pillow.

I understood they were "Hindu of a sort," and parts of their Code referred to regulations under their Hindu religion. But in the farmhouses, one seldom saw, as one does in India, images and clay deities, or corners of rooms reserved for worship.

That my appearance amused the people was obvious. Here I was, a woman, yet I was wearing trousers—something women in this land never wore. Like the village women of India, they often wore full skirts, though not as long as those of their

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Coatis on slack wires twice a day
have worked miracles on hospitalized children

The Coati Cure

By WILL BARKER
Drawings by Carl Burger

COATIS, slim raccoon-like mammals from South and Central America, have "joined the staff" of University Hospital at Ann Arbor, Michigan.

Doctors at the hospital were concerned about the tears and melancholy faces on some of the patients in the children's division. Some of the kids were even refusing to talk. Medicine wouldn't help, so animals were given a chance.

Among the pets brought in were coatis. When the long-nosed, coarse-furred coatis were released, they put on a show that was hard to resist. Wires had been strung the length of the wards, well above the patients' heads, and the coatis clowned on them like comedy acrobats in the circus, using their tapering 20-inch tails to keep their balance, as tightrope walkers use poles.

▼ AT TIMES a coati climbs as high as 100 feet to gather fruit and nuts.

Their antics brought smiles to the faces of the sober little patients, and many a case of melancholia was put to flight.

Naturalists have long known of the coati's ability to hold an audience. Frank M. Chapman, the well-known bird scientist, even tested their ability, using a free meal as the inducement for hazardous maneuvers on a slack wire. His star was a distinguished artist named José, who endlessly entertained the scientists stationed at Barro Colorado Biological Station in the Canal Zone.

The coatinundi, as the animal is sometimes called, has dark rings on its tail, a pale brown mask across its dark eyes, and a long rubbery snout from which the scientific name *Nasua narica*, meaning the nosy one, has appropriately been taken. This long upturned snout



is good for grubbing out insects and roots, which the coati relishes along with eggs, nuts, fruits, and lizards. The animal's range has recently stretched to include parts of Arizona, New Mexico, and Texas.

The coati seems to be hungry most of the time, and it hunts day and night. Sometimes it looks for food on the ground, where it walks on all four feet. Sometimes it takes to the trees, moving among the branches with the agility of a monkey. Often a coati will climb as high as 100 feet to gather almendro nuts. While seeking food, it often takes time off to rest. If the animal is in a tree, it curls up into a ball on any convenient limb—a posture that it also assumes when sleeping on the ground. To descend, it comes down the tree head first.

In the United States, the coati lives in rocky, not-too-heavily wooded areas. The mother brings forth from four to six young in the spring or early summer, in a cavity

among the rocks. Young coatis are darker than the adults, and the rings on their tails are more distinct.

By the time a male is full grown, it will weigh from 10 to 25 pounds. Females are considerably smaller. Males usually live alone, but females and young travel in bands of fifteen or more.

Tourists in the Southwest who hit the road early in the morning are likely to believe they are seeing things if they catch sight of a dozen or so coatis bounding over the ground. In the half-light, the animals look like phantom creatures trying to reach cover before full daylight is upon them. They bounce along at a rollicking gait, with their constantly waving tails held horizontally or at any angle up to 90 degrees. When the coatis change or reverse their course, they pivot on their hind legs instead of turning around, then swing off in a new direction.

The coati makes a good pet. It

is affectionate, odorless, washes after every meal, and is easily housebroken. On the other hand, its inordinate curiosity makes it an agent of destruction and a trial of patience. A coati explores every nook and cranny of a house. In its wake, vases, china lamps, and crystal objects crash to the floor.

Another characteristic of the coati that is often trying is the animal's craving for attention. If left by itself, it whimpers like a child. This whimpering so unnerved the owners of one pet, that they hired a "coati sitter" for their evenings away from home.

Although the coati has its shortcomings as a pet and is of no value as a fur animal, it has shown itself at the hospital at Ann Arbor to be of therapeutic value, owing to its aerial antics, which bring smiles to the faces of ill children. So, who knows, the standard prescription for melancholy kids may someday be "coatis on slack wires, twice daily."

▼ THE COATI is a very curious animal. In fact his name means "the nosy one!"

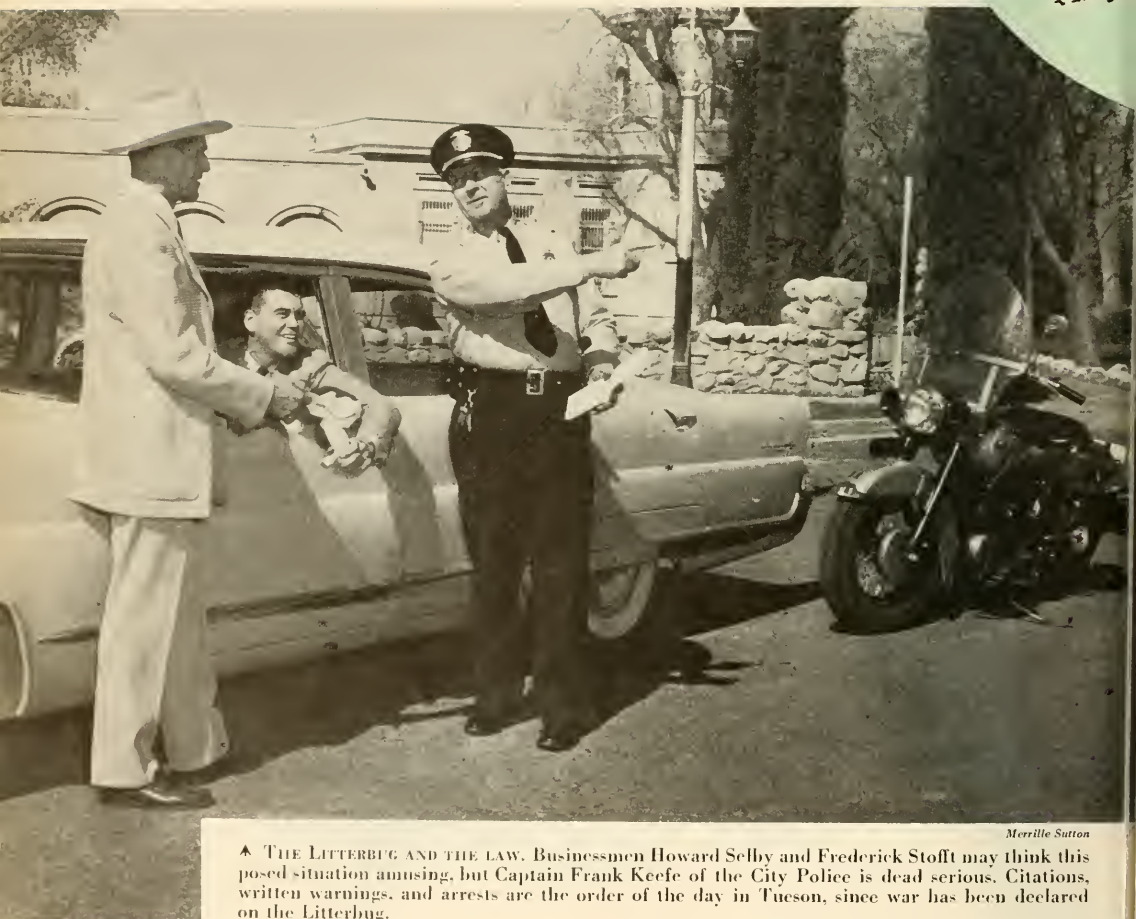
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You CAN catch the Litterbug!

Hope against an increasingly difficult problem comes from a community that refused to yield an inch of ground to the people who leave their rubbish on other people's land

By ANNETTE H. RICHARDS



Merrille Sutton

▲ THE LITTERBUG AND THE LAW. Businessmen Howard Selby and Frederick Stofft may think this posed situation amusing, but Captain Frank Keefe of the City Police is dead serious. Citations, written warnings, and arrests are the order of the day in Tucson, since war has been declared on the Litterbug.



Merrill Sutton

▲ SABINO CANYON, north of Tucson, was where a ranger found 300 beer cans in 100 square feet one Sunday morning. Since Boy Scouts, De Molays, and YMCA Hi-Y youths have been giving the canyon a going-over and a campaign in public education has been begun, depredations by the anonymous Litterbug have been decreasing.

THE people of Tucson, Arizona, declare that you can get him, and they're proving it. Their achievement in civil improvement should give heart to hundreds of other communities that are plagued by the Litterbug.

Not that the job will be easy. But it's better to catch him than to keep on spending \$30 million a year picking up after him. That's what it is costing the country, according to Keep America Beautiful, Inc., the national organization formed in 1953 to combat Litterbugism.

Tucson saw that the problem was getting worse all the time. More cars, more leisure time, more spending money, and more kinds of "disposable containers" that aren't properly disposed of have been increasing the cleanup burden year

by year. Where ten people once tossed their garbage out on a mile of road, a hundred now do so.

Not far north of Tucson, one Sunday morning in April, Assistant Ranger William Hughes stumbled upon 300 beer-can calling cards, plus steak scraps, papers, boxes, and signboards strewn over 100 square feet of an otherwise beautiful picnic area in Sabino Canyon in the Catalina Mountains. The previous night's orgy of 100 anonymous litterbugs cost the maintenance crew more than an hour's work, simply to restore the site to presentable condition for the morning's influx of picnickers.

In 1955, the Coronado National Forest, which flanks Tucson on three sides, had a \$40,827.17 cleanup bill, according to William H. Woods, Jr., Supervisor. Half the labor force of Tucson's 55 municipal parks spends its time picking up after litterbugs. The street sweeper brings in an average nightly haul of eight cubic yards of litter from the downtown business district.

One of the worst aspects of the problem around Tucson was the unhealthy habit some county resi-

dents had of dumping their family garbage promiscuously, usually over week ends. Many other communities are familiar with this tendency, which usually results from the necessity of paying for private garbage service outside city limits. Distances to a sanitary fill are sometimes great, and many householders fall prey to the temptation to dump en route when no one is looking. When the exterior desecrator does his work after dark, it is no simple task to identify him. But in a desert region like the country around Tucson, his handiwork is most conspicuous, for the landscape stands naked to the blight of beer cans, broken glass, old newspapers, and cleansing tissues.

Last fall when public-spirited Tucsonians decided to halt the Litterbug, they knew there was no single solution. Initial spark plug of the movement was a young conservationist, Joseph F. Carithers, Superintendent of Tucson Mountain Park, the largest county park in the nation. As Chairman of the new Arizona Conservation Coordinating Committee, Joe had no trouble choosing his first line of attack. He



Since her teens, the author has lived an outdoor life. As a free lance writer she now specializes in conservation, with archeology as a second interest.



Education with Enforcement

► WHILE MAYOR OF TUCSON, Fred Emery sponsored the spectacular cleanup of Sabine Alley in 1952. Here he dramatizes the Anti-Litterbug campaign with trash can, wheelbarrow, and the litter that symbolizes civic slovenliness.

wanted to eliminate the \$17-a-day cleanup bill the community was having to pay for this one park alone.

So he asked Morley Fox, the Arizona representative of Keep America Beautiful, if he would help start the ball rolling in Tucson. Six weeks of intensive leg work followed. At the Litterbug Protest meeting on November 30, 1955, Joe appointed as Temporary Chairman of an Anti-Litterbug Committee Mrs. Mabel Weadock, civic-minded chairman of the Roadside Parks of the Desert Garden Club of Tucson.

Mrs. Weadock made the fur fly. An organizational meeting of the Stop the Litterbug Committee last February 6 gave notice to local litterbugs that their days were numbered. Under the permanent chairmanship of Christopher A. Reilly, Tucson businessman, things began to pop.

Solution of the problem called for greater knowledge of litterbug psychology. It was soon discovered that most litterbugs do not consider themselves litterbugs. Only the thoroughgoing litterbug throws out whole bags and boxes of trash. The average offender just flings away one thing at a time—a cigarette butt, a facial tissue, an orange peel, or a candy wrapper. It is often done so quickly from a speeding car that scarcely anyone sees the actual act. Sufficient legal evidence is difficult to obtain. And because the public does not take piecemeal litterbugging seriously, law officers have been reluctant to enforce the statutes that exist in 43 states. Besides, many of the laws were too weak.



Merrille Sutton

When the campaign got under way, the litterbug in Arizona no longer received lenient treatment. In Tucson, Mayor Don Hummel, Chief of Police Don J. Hays, and Pima County Undersheriff Waldon Burr gave the public due notice that the laws were on the books and were to be enforced. The courts asked for test cases. And the Litterbug Committee began to educate John Q. Tucsonian out of his untidy habits by supporting the enforcement officers and giving publicity to violations and convictions.

Both state and city codes were tightened to catch the litterbug. State Code Section 9-442 makes it a misdemeanor for any person to dump trash or refuse on any public or private land except at designated places. Section 18-162 specifically singles out highway litterbugs who toss garbage or other malodorous objects on state or county highways or on public thoroughfares, or within 20 yards of them. Moreover, it is now provided that if the littering is done from an automobile, the case will be handed over to the Director of Motor Vehicles, who shall suspend the offender's driver's license for up to 30 days. The city code at present contains six pages of trash regulations and provides that "it shall be unlawful for any person to deposit garbage, trash, or refuse in any public street, alley, or other public place." Violation of any of these laws can land a litterbug in

jail for 30 days and cost him \$100!

The latest legal wrinkle is S. B. 26, which went into effect July 14. Under this law, a litterbug's certificate of car registration may be suspended for 30 days, and the driver or owner of a vehicle from which trash is thrown is held legally responsible. Tucsonians discovered that it wasn't enough to dust off the old laws; new teeth had to be put into them.

Gene D. Reid, Superintendent of the Parks Department of Tucson, announced that two security officers appointed during the past month were going to show the first litterbugs they could catch that the Parks Department meant business. A municipal ordinance that became effective in January, 1955, provided the authority.

Proper Garbage Cans Used

The City Sanitation Division also stiffened up. It recently adopted an inspection program involving the condemnation of defective garbage cans used by homeowners. A red tag is attached to all cans that do not conform to the legal requirements as to size, cover, handles, and general condition. City Ordinance No. 1322 supports the Sanitary Division by notifying offenders that they have committed a misdemeanor. Ten days after notification, Sanitation Inspector Bernabe Trejo checks up on compliance. Public opinion has rallied behind him in

Teach the Children and You Will Teach the Parents



Merrille Sutton

▲ MRS. IMOGENE MYRLAND (here shown demonstrating how to make a car trash receptacle) supervised the most spectacular cleanup ever seen in Tucson.

➤ A POSTER CONTEST was part of the program to make the children litter conscious at Flowing Wells School.



Merrille Sutton

the realization that without thorough insistence on proper garbage containers, the health and beauty of the city cannot be insured.

Thus the various city departments have cracked down on litterbugs, each using its own legal weapons.

It had been unheard-of for a litterbug even to be fined \$10, but on February 17, 1956, this happened to a man who dumped trash on "A" Mountain, a favorite sunset lookout point above the city. Then an eighteen-year-old University of Arizona student tore up his parking violation ticket and threw it onto the street. A witnessing officer booked him on—of all things—the Litterbug charge. The young culprit had to post a \$150 bond to be released from jail. The next morning, when he appeared in court, he pleaded guilty. His sentence? Five days in jail or a \$50 fine. Sobered, he chose the latter. Litterbugging, he discovered, was no joke. Both cases received wide publicity, and the public began to look twice at the signs forbidding dumping along streets and highways.

About eight citations and sixteen written warnings were issued to mild or dyed-in-the-wool litterbugs in two or three months, early this year in Pima County. A citation is

Jack Sheaffer



▲ SCHOOL CHILDREN have been taught periodic cleanup duties. Playground infractions carry a penalty of additional service on the cleanup "chain gang."

Jack Sheaffer



▲ FIRST PRIZE in the schoolwide cleanup contest was won by this mound, collected by fifth-graders at the Liberty School.

YOU CAN CATCH THE LITTERBUG!



Success Depends on Disposal

➤ SUCCESS AGAINST THE LITTERBUG depends on proper disposal facilities. Here City Sanitation Inspector, Barnabe Trejo, is demonstrating an improved dogproof can and rack to Mrs. Joe L. Lane of the Stop the Litterbug committee.

given, for instance, when a person deliberately drops an ice cream container on the road. Undersheriff Waldon Burr reports that most people react to a citation by saying, "Why did you have to pick on me?" Most written warnings are given to well-intentioned people carting their trash—but without adequate covering on their trailers—to an authorized sanitary fill. Persons thus reprimanded in writing usually respond, "I'm sorry, Officer. I didn't realize I was littering the highway. I'll be more careful." Areas in which the warnings have been issued are already noticeably cleaner.

Undersheriff Burr says, "If we can bring people around without arresting them, so much the better. The voluntary way is better than the penalizing way. Most litterbugs have been doing it for years without thinking. We must train people to think. Some people do have to be penalized before they will think. In the long run, public education is the answer."

But education in this new field has to be a many-sided affair. The Tucson experts say that any anti-litterbug committee has to drive home the realization that the *public* is responsible for the appearance of roads, forests, parks, and countryside.

Quiet-spoken Mrs. Imogene Myrland, Director of the Tucson Nursery School and a member of the committee, has done yeoman's service in the schools of Greater Tucson. As the representative of the Altrusa Club, she supervised the most spectacular cleanup in the city's 79-year incorporated history. In June of 1952, 45 truckloads totaling 10 tons of debris were removed from one small street, Sabino Alley. And the street has never reverted to its former condition. "Teach the

children, and you will teach their parents," says this wise administrator.

So schools are a primary arena in this campaign. As a starter, the U.S. Forest Service movie, "Woodland Manners," was shown to children in elementary, junior high, and high schools of the city and the surrounding country, in conjunction with brief anti-litterbug talks. Then each school took over in its own manner. The activities of the children varied, but with the same outcome: the litterbug habit was dealt a body blow.

At Flowing Wells School, seventh graders made the Litterbug problem a citizenship project. They organized an assembly program and obtained the co-operation of other teachers in a schedule for a cleanup patrol. From fourth through seventh grades, 71 pupils participated in a stimulating poster contest. The posters were displayed prominently near trash cans, in home rooms, offices, and the school cafeteria. The results? Markedly cleaner grounds and children more apt to pick up the litter they saw. Principal Mrs. Iola Frans said that the cafeteria litter problem had always been a headache but that the anti-litterbug project had worked wonders.

At the brand-new Liberty School, 350 first through sixth graders worked like troopers Monday through Thursday, scavenging every vestige of litter from their twelve-acre grounds before dedication ceremonies. The fifth-grade winners of the contest roasted their prize wieners on the flames of their eight-foot-high trash pile. Others toasted marshmallows. As a reward for their participation, each child received ice cream.

Says Principal O. K. Wolfenbarger, "They certainly have become



Merrille Sutton

good housekeepers. Children now ask the teachers for *permission* to pick up papers in the yard."

Students at Davis School made a hideous litterbug from the trash found in their playground. And at Wrightstown School, it has been decided that children who break playground rules must be punished by serving on the "chain gang," which picks up litter that collects outside the fence.

TV and Radio Aids

While parents *can* be reached through their children, the anti-litterbug committee leaves no stone unturned in an effort to reach the adult community directly. TV and radio listeners get periodic reports on progress; and daily, weekly, and special newspapers carry a barrage of anti-litter propaganda and information.

Tradesmen and public employees have also been enlisted. A laundry on an arterial thoroughfare once inserted in its marquee: "Takes More Than Insecticide to Stop Litterbugs." Posters have appeared in shop windows and on school bulletin boards reading, "Help Keep Our Roadsides Clean—Carry a Trash Bag in Your Car." And stickers have cropped up on car windows: "Don't Be A Litterbug—Keep Arizona Beautiful."

Most startling of all, perhaps, is "Mr. Litterbug" himself. He wears



Merrille Sutton

▲ **CUTTING DOWN THE COST:** a front-loading truck that shovels trash up and overhead. Previously a driver and three helpers could remove only four tons a day. With this machine, the driver alone can pick up 22 tons.

▼ **SANITATION SUPERVISOR MURRAY D. SNYDER** demonstrating a covered city garbage truck that has helped Tucson exterminate the Litterbug. At right: **Fred Emery**, in charge of soliciting the co-operation of commercial firms in Tucson.



a costume modeled on the famous emblem created by the National Council of State Garden Clubs and runs about town leaving a typical litter trail. He has spindly black legs and arms, a puffy yellow-and-black striped body with wasplike tail, and a huge round, green head with a patch over one eye. His nose points in one direction and a long cigarette in the other. This horrible monster is no respecter of persons. Bearing a sign that asks, "Are You a Litterbug, Too?" he dashes through offices of government officials, bankers, and merchants, and into department stores and school assemblies.

While Tucsonians are hammering away at law enforcement and education, they are also looking for ways of making cleanliness easier. After seeing a picture in the paper suggesting how to make an automobile trash bag with an ordinary paper bag and a coat hanger, the ladies of the Tucson Medical Center Auxiliary decided to make something more permanent. To their delight, their cloth litterbags sold like hot cakes at their annual bazaar.

Gas stations and department stores have agreed to sell the Auxiliary's "Don't Be A Litterbug" bags

with insertable paper containers, and the backlog of orders is considerable.

Davis-Monthan Air Force Base donated 180 salvage 50-gallon oil barrels to the U.S. Forest Service, which gave them to Pima County. They were stenciled with anti-litterbug signs and placed at strategic locations in parks, picnic areas, and along roadsides by the county highway department. Emptying them periodically is a lot cheaper than having to pick up litter bit by bit. The county is also re-using damaged road signs by painting them with the words "Don't Be A Litterbug" and placing them at key points along highways.

Dog-proof Cans

The City Sanitation Division is currently pushing two types of dog-proof garbage cans. The 24 ten-cubic-yard Dempster-Dumpsters it installed for merchants in downtown alleys have eliminated much of the litter caused by two-legged and four-legged garbage-can raiders. It plans to install 24 more. A special truck picks up the containers, carries them to the dump, and returns them empty. The saving in



manpower from emptying endless rows of garbage cans is substantial for the city, despite the cost of the big containers. Merchants, reluctant and even opposed at first, are now sold on this neat disposal system.

The Stop the Litterbug Committee staged its first cleanup on April 28 and 29, 1956, selecting ten schoolyards as trash collection centers for local residents. Trucks and trailers were made available by city and private garbage services. Every school area was alerted by its school children. Boy Scouts rang doorbells and asked for homeowner co-operation. Newspapers, radio, and TV informed Tucsonians of this opportunity to clean up their city.

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YOU CAN CATCH THE LITTERBUG!

Picture the Fish

It is not necessary to mount or even photograph
your prize specimen today. Make a print of it
and you will have an artistic,
accurate record of every scale and fin!

By DOROTHY GOODWIN

NO one knows how it all started but there is an old Japanese folk tale that goes like this.

Once a Japanese peasant caught a very beautiful silver fish in the private lake of the emperor. As he was about to gather it up to take it home he was astonished to have the fish beg for its life and to hear that it was actually the son of the emperor, transformed by an ambitious priest who had much influence at court with the empress. Moved to pity by its plight, the peasant inquired what he could do for it, other than sparing its life. The fish then said that if he could confront his enemy, the priest, the spell would be broken. "Take me home with you," the fish said, "and I will tell you what you can do."

At the peasant's house the fish commanded his benefactor to lay him upon a piece of rice paper. When the peasant removed the fish, as instructed, there remained a gleaming print of the fish, resplendent and perfect in every detail! The fish then ordered the peasant to take this print to the emperor, who loved all things beautiful and artistic. The emperor was pleased with the gift, rewarded the peasant handsomely, and the print was hung in the palace.

In due time the priest paused before the fish's portrait. In a thrice the restored prince stood before his enemy and the tale ends with the sudden death of the wicked priest at the hand of the prince.

AMERICAN soldiers in Japan who wished to fish in one of the many public fish ponds learned that fishing tackle is available in any shop displaying a fish print in its window. Less evident to the casual tourist in Japan is the fact that the making of these fish prints is also a highly developed art—a new artistic form. But it is the fish scientist, perhaps, who is the most enthusiastic maker, and collector, of these fish prints, for in them he has found a more accurate and detailed record

of the characteristics by which fish are identified than is to be had in any photograph.

Artists and ichthyologists are organized into a society devoted to the making of these fish prints (*gyotaku*). The work of *Gyotaku-no-kai* (Fish Print Friends) has been exhibited not only in Japan, but in the United States, at the American Museum of Natural History this year. A magazine, *Tsuribito* (Fisherman) is sponsored by three *gyotaku* artists, and the "Story

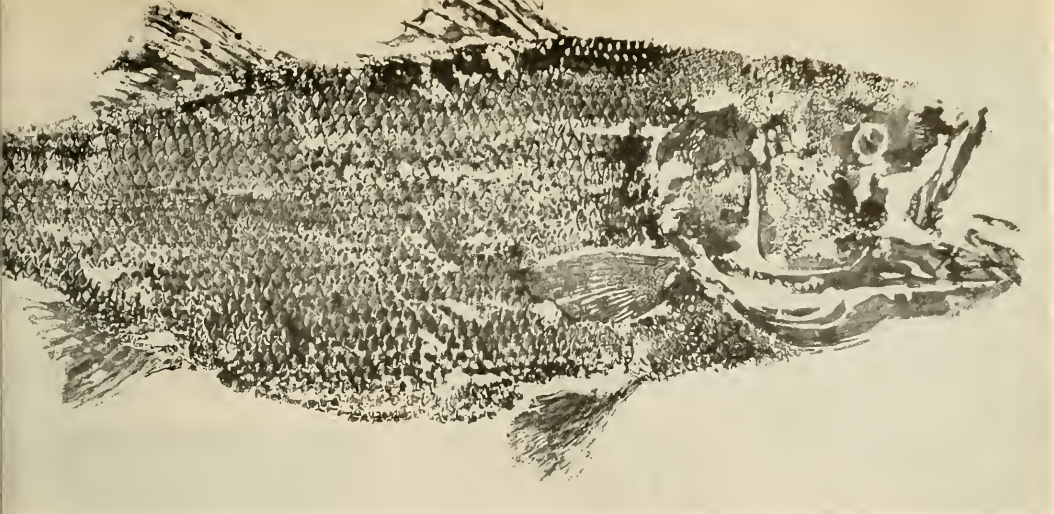
of *Gyotaku*" was told in its July, 1955 issue. In that article *gyotaku* artist Isshu Nagata reveals that he learned the method from the archeologist, Shiro Shinozaki. He remembers that the archeologist also showed him an old book entitled *Rubbing Books and Gyotaku*.

In the United States, school children have always enjoyed making prints of leaves and flower petals. It was in 1932 that fish prints were first introduced to the American

ストライプバス
三十一斤六オンス
新スーモ子魚油のそり
九月一日

Striped Bass
36 pound bass
at Suiran
Sept 18th 1941

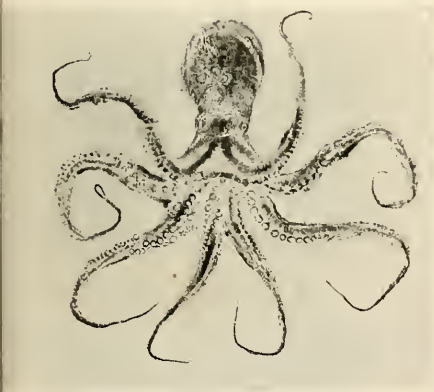




▲ THERE ARE NO LIMITATIONS to what one can do! Provided, of course, that one has the patience, the time and the space in which to make a print of a huge fish such as this 36-pounder caught near San Francisco Bay. It provided a subject for the deft touch of Chiura Obata who here employs the direct method.

otaku-no-kai (Friends of Fish Print) in Japan. To left is a small ray and to the right is an octopus.

▼ A SKILLFULLY EXECUTED PRINT by the dean of the Gyotaku school, Isshn Nagata. The direct method was used.



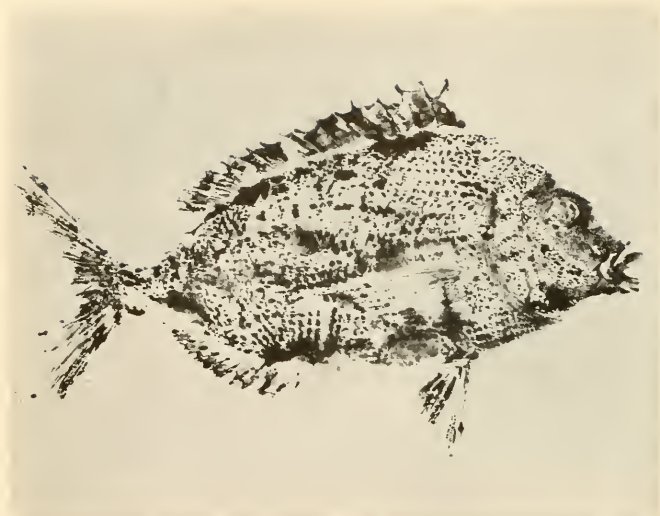
public by a Japanese artist at the University of California. In that year Chiura Obata's print of a steelhead was reproduced in the *Oakland, California Tribune*. Since then Mr. Obata has taught many of his interested students and friends how to make *gyotaku*. Some are still enthusiastic devotees of the art; among them must be mentioned Janet Canning, an outstanding ichthyological illustrator in this country.

But it is not only artists and

ichthyologists who have become interested in *gyotaku*. Learning of the prints from an American soldier who had become acquainted with *gyotaku* in Japan, one American housewife who wanted an opportunity to create something artistic tried her hand at it. When she became an expert devotee of *gyotaku*, her husband, an artist, had to make one too, and soon he also was turning out fish prints as a hobby. His employer, the J. Walter Thompson advertising

agency, was not slow to realize that it had something special in its own back yard. Last year Joseph Feké's prints were exhibited in his company's offices throughout the country.

The circle of *gyotaku* enthusiasts continues to grow. A composite cover of Joseph Feké's prints graced the October, 1955 issue of the magazine, *American Artist*. It led a reference librarian in the New York Public Library's Art Department to make one too. "It is easy," re-



▲ "MAKING A FISH PRINT is a direct way to rediscover the beauty and design inherent in natural forms which are a source of continual delight," says Roger L. Crossgrove whose initial effort is reproduced above. An instructor in Nature Structure at Pratt Institute, he discovered that painting soft colored backgrounds on the paper prior to the direct method gives a pleasing effect. He also recommends patting the paper with a moist sponge just before removing it.

ports Leander Fornas, whose hobby is woodcuts.

How to do it

There are actually two methods of making *gyotaku*—the direct and the indirect. The direct method, which is the easier, comprises the following steps:

1. Take a fresh fish and wash its outer surface well. Place it on a newspaper and rub with salt to remove all the oil and mucus from the scales. Then place it on a dry newspaper, a drawing board, or, as one person recommends, an empty cardboard box. It is best to secure it by pinning the fins and tail to the working surface.

2. Apply ink on the fish with a brush. Japanese ink called *Sumi* or a Chinese ink available at art supply stores is best, or India ink that has been allowed to thicken can be used. If color is desired, make a sketch of the fish first, and note where color is to be applied. For this, finger paints used manually are recommended.

Apply the ink quickly and evenly going from the head to the tail, including all the fins. The outline gets a thicker coating of ink than the center. Do not put ink on the eye. Blot up excess ink with a sponge or paper toweling.

3. Put a piece of fine, soft, thin paper (rice paper or *washi* available at art supply stores) over the fish carefully and press with soft cloths using the palm of the hand, from the head to the tail.

Peeling off the paper is a delicate operation; start at the head and remove it slowly. Paint in a black dot for the eye.

By the indirect method the fish is cleaned and prepared as above. Then a piece of slightly damp paper is molded over the fish while the fish is still moist. Creases in the paper must be avoided. Apply the ink to the outlined fish gently, with a powder puff or with Q-Tips. Remove the paper carefully as above.

If you are now anxious to try *your* luck at making a *gyotaku*, we shall say fin to our fish story.

THE DIRECT METHOD



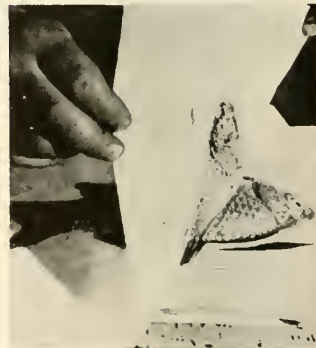
SUMI, a thick carbon black ink, is here applied to the fish after it has been wiped clean.



ARTIST ISSHU NAGATA applies a piece of rice paper over the fish and presses gently but firmly.



MORE PRESSURE is applied and the detailed outline of the fish begins to appear.



Courtesy Scope Magazine, Upjohn Company

THE PAPER is slowly and carefully peeled off to reveal all the salient characteristics by which fish are identified. Mounted and framed, it is a pleasing eye-catcher on any wall.

The most successful work took place in Pueblo Gardens. Though this section was cleaner than most neighborhoods at the outset, citizens picked up almost three tons of extra litter. The subdivision looked noticeably cleaner on April 30. As Murray D. Snyder, Sanitation Supervisor of Tucson, said, "Everything we do makes people more determined to stop the litterbug. This cleanup may not have ended the problem, but it has been a good start. The next one in the fall will be better."

Members of the Stop the Litterbug Committee represent a good cross section of the community—business, banking, medicine, home-making, garden clubs, schools, civic groups, and the writing profession. Word of the anti-litterbug war in Tucson has traveled across the nation, and the city has much to be proud of. However, though their enthusiasm and energy has accomplished much, Tucsonians are willing to admit that the battle is not actually won. Progress so far has whetted the appetites of those dedicated to keeping their community beautiful, and they hope that similar determination can spring up in other communities until a nationwide movement is operating.

Other towns can do as Tucson has done if they will form committees and co-ordinate the efforts of energetic citizens. But the job requires time, and the fighting must be waged on several fronts. There must be law enforcement, education, actual cleanup, and provision for adequate dumping facilities for residents as well as for travelers. Litter in drive-in-theatres and vacant lots, refuse left by beer parties and canine garbage-can raiders, and debris left by picnickers, campers, pedestrians, and motorists—all must be eliminated. A little nucleus of filth is an invitation to every potential litterbug. Every citizen from the cradle to the grave must be taught that even the flicking of one sandwich wrapper or the dropping of a lone banana peel contributes to the mess he abhors and ascribes piously to others.

Morley Fox, Arizona representative of Keep America Beautiful, declares: "I don't think that there is a group that has done so much in such a short time as this one here in Tucson." But for the future, Tucsonians say the battle will be won when the pest learns to behave in private as well as he is learning to behave when people are watching him.



DEMETRA and the headless doll

A little doll, wilted and headless, is a thing of wonder to Demetra. It is the only toy she's ever owned. Demetra's doll is a symbol, a symbol of the bitter poverty which grips Greece—torn and shattered by war and earthquake.

The only "home" Demetra has ever known is a large warehouse in Athens partitioned with ropes and rags to make "rooms" for many refugee families. Demetra's father cannot find employment in poverty-stricken Greece; her mother has even sold her own winter jacket to buy milk for her baby. Demetra's parents pray that someone, somewhere, will help them care for their little daughter.

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The Screen

Authoritative comments on films
in the field of nature, geography and exploration

The Silent World

Reviewed by JAMES W. ATZ
Assistant Curator, New York Aquarium
New York Zoological Society

and

DOROTHY GOODWIN
Film Editor



▲ PYROTECHNIC TORCHES brilliantly light the gloom as these divers descend the depths of the ocean.



▲ A LARGE GROUPER which, upon being fed, attached itself to the divers and begged for more food.



▲ THE AQUA-LUNG makes underwater photography relatively easy.

IT is a pleasure to be able to recommend another film as good, if not better, than *The Secrets of the Reef*, which was outstanding. Jacques-Yves Cousteau has given us such a film in *The Silent World*, the story of the exciting marine explorations of the *Calypso* Oceanographic Expeditions, headed by Captain Cousteau. At the Cannes Film Festival this year it won the top award—the first time in 25 years that it has been given for a non-fiction film.

We are privileged to see in this picture the high spots of 10 months work involving 2 cruises which covered 50,000 miles in the Mediterranean, Red Sea, Persian Gulf, and Indian Ocean. Filmed in beautiful Eastman color, it is a thrilling experience from start to finish (86 minutes).

Although successful scientific undertakings, these expeditions, as recorded on film, are anything but dull. First there is the superbly beautiful photography of both underwater marine life, and diving operations. Then there are the skilfully interwoven lighter moments of human interest drama both on the motorship *Calypso*, on land, and underwater. Last, but not least, are the many descents into the deep to collect and observe marine life and which provide adventure of a rare sort.

Of interest on the technical side are the innovations that have made the *Calypso* peculiarly suited to her work. Extensively reconverted in accord with Captain Cousteau's designs for a research ship, she has such unique features as an underwater observation chamber, a diving well amid-

ships, and a cage in which photography can be accomplished in shark infested waters.

The Aqua-lung (invented in 1942 by Captain Cousteau) is used by the divers who cover their nostrils and mouths with light masks. The swimming power of their feet is augmented by wide rubber "fins." The average depth attained in the film is 80 feet and one shot at 247 feet is the deepest ever made by a hand-held camera. Lighting was provided by dozens of 6,000-watt floodlights and one spectacular sequence at the very outset was illuminated by pyrotechnic torches. For many sequences the divers used marvelous submarine scooters which actually tow from one to four men and make possible long underwater excursions without fatigue. Powered by silver-cadmium batteries, these scooters make a top speed of four knots an hour.

Of the marine life observed, an outstanding sequence was a "ballet" of diving, high-leaping porpoises in vast numbers—cutting a swath perhaps half a mile wide—who the *Calypso* followed for some time. This is certainly the best photographic record, both above and below water, of such leaping and diving. The excitement and drama of this event is heightened by the interpolation of music (trumpet and drum fanfares).

The East Indian coral reefs contain many kinds of fish. In a single coral reef more than 200 different species may be found. The Cousteau expedition there discovered one such reef where more than a dozen different kinds of beautifully colored groupers were observed—in addition to angel fishes, butterfly fishes, demoiselles, a unicorn fish, puffers, taogs, parrot fishes, surgeon fish, grunts and snappers, jacks, and one shot of a zebra fish.

All in all—for a study of marine life, beautiful photography, and real life adventure—this film will be hard to beat.

▼ HIGH-LEAPING porpoises filmed in the Gulf of Aden.



▼ A BALLET-LIKE formation of divers being towed by submarine scooters.



could not have escaped through their circle. Yet he was not there.

Dew of Heaven approached the tree and found a strange little insect exactly where her Prince had been standing. She then realized that the Goddess of the Moon must have heard her plea and transformed the young man.

"Máceech, Máceech," she cried, taking the insect from the bark of the tree. "Thou art a man." She attached the insect by a strand of her hair, to her dress near her heart. And from then onward, she always wore the Máceech, as it came to be known, for she loved it dearly, believing it to be Ek-can himself.

So, from that remote time, this

insect has always been a talisman of good luck in Yucatán, particularly among young girls.

You can see from the photograph, taken from life, that the Máceech is not a particularly exciting looking insect. Normally, it moves very slowly. Its wing cases appear to be camouflaged to resemble bark, just as with many moths and other insects.

You wouldn't look at it twice unless you happened to be a son of the soil of Yucatán, but in that case you would immediately take it home. In Yucatán, nobody kills a Máceech. When one is found, it is cherished and taken with a bit of the bark of its "home tree." Then a little silver ring is placed around

it, between the thorax and the abdomen, to which is attached a tiny chain that leads to its piece of bark. The insect is kept as a charm and normally lives for years quite happily.

Insect scientists maintain that some insects, in their adult form, consume virtually no solid food. True enough, our little Máceech seems to get along on almost nothing. The Mayan tradition is that it lives almost indefinitely in association with its tiny piece of bark. It has endeared itself as a symbol of happiness to all Yucatecans, who traditionally regard it as something almost supernatural.

We know a Yucatecan lady living in Mexico City who wanted a Má-

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cech as a lucky charm. In due course, one arrived from Merida by air, complete with chain and piece of bark. Nowadays, on her dressing table, it appears to live in perfect happiness. When she goes out in evening dress, she sometimes wears it on her bosom, as other ladies might wear an orchid. Possibly stimulated by the warmth of her body, it becomes reasonably animated on these occasions and goes for a walk around its little piece of bark. For over a year it has lived on her dressing table, apparently without having eaten any-

thing, unless it nibbles bark in the darkness of night. *Quien sabe?*

For the owner, it is a proud reminder of her Yucatan origins. For others, it is a constant source of interest when they meet her on formal occasions.

Quite recently, the writer also became the proud owner of a live Mácech, whose portrait is illustrated here. It is complete with silk halter and bark. Our private Mácech resides on top of a bookcase in our living room. It is a friendly little creature, buff-gray with black legs, and a little over 1½ inches

long. When people come to look at it, it waves its little antennae slowly, as though to greet them. It always livens up when put in the warm sunlight. During the three months we have had it, it has eaten nothing. We are trying hard to devise a way to make its life more exciting.

Its name seems to have double justification. The word Mácech links it with the legend through the phrase "Thou art a man," whereas Yucatecan friends of ours with a knowledge of Maya point out that Ma'kech means "Does not eat."

Letters

The Pesky Clothes Moth

Sirs:

I am writing to enlist your aid in answering a question that has plagued me for a long time.

My wife gets excited every time a moth gets into the house, whether it be large or small. Now I know that not all moths lay eggs in woolen cloth. I've always thought that the real large ones did not. Can you

clear this question up for me? Which moth, or moths lay eggs in wool? Is it only wool cloth that they hatch in? Do they lay eggs outdoors too?

FRANK SAYRE

Baltimore, Maryland

John C. Pallister of the American Museum of Natural History supplies the answer:

Only a few very species of the thousands of kinds of moths lay eggs in wool. They are all small, not even as much as an inch in wing-spread. In the United States there are three common clothes moth species, and a few other very uncommon ones. Other countries have species of their own. Unfortunately although these pests are so very plentiful it is impossible for anyone but a specialist to identify an adult clothes moth. A great many small moths with completely harmless habits look very much like the clothes moths. The larger moths that may be attracted through your open windows toward your lamps deposit their eggs in vegetation.

The three species of clothes moths most frequently found in the United States probably were all brought to this continent from the Old World. They are all tiny whirling creatures of a dull beige color, undistinguished-looking to the naked eye, but showing lovely fringed wings under the microscope.

The commonest and most widely distributed is the webbing clothes moth, *Tineola bisellella*. The larva webs together particles of the material on which it is feeding with strands of silk which it spins. The case-making clothes moth, sometimes known as the old-fashioned clothes moth, *Tinea pellionella* constructs a portable case of the food material and silk in which it lives as it feeds. The tapestry moth, *Trichophaga tapetzella* is the least common. It is slightly larger than the preceding species, ¾ inch wing spread. Its larva forms silk-lined galleries through the material on which it is feeding. The



▲ A CLOTHES MOTHS laying eggs.

structures built by the larvae easily identify the different species.

The food habits of all three species are very similar although each shows some preferences. They attack fur, hair, wool, mohair, feathers, and materials made of these animal products, such as carpets, blankets, clothing, and upholstery. Cotton, linen, rayon, nylon and silk are practically free from attack by clothes moth larvae, unless the material has been stained by grease, food, or other animal matter.

All small moths found in homes are not necessarily clothes moths, for there are a number that are found around stored food products of vegetable origin. These are the several species of grain moths which are frequently brought into the home in packaged foods such as cereals, spices, dried fruits and nuts.

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Sirs:

Your December, 1955 cover was of a Climbing Screwpine (*Frycinetia arborea*) native to Hawaii where it is called *icie*. I am very keen to add it to a small collection I have of fine tropical climbers. Experience has taught me that anything grown in Hawaii will also grow in southern Florida. I have made inquiries of four Honolulu nurseries for this Climbing Screwpine, but have had no luck. Can you help me secure a fair starting plant of *icie*?

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Letter from Nepal continued from page 131

Indian sisters. Certainly they would never have been as devoid of jewelry as I was. Even those with only rags on their backs often sported colorful beads around their necks and wore chiseled gold lockets. As for my rubber-soled shoes, I am certain they thought them foolish. I should have gone barefoot, for comfort and better climbing.

The men seemed pleased when I showed interest in their *kukri*, that all-purpose knife which in time of war has been known for its efficiency in slicing the head of an enemy in one clean stroke. They wore them casually tucked in front of a long rag which they wrapped around their middle.

On cold days many of the men wore trousers, the Nepalese kind, loose at the top and tight below the knees. But with the appearance of rain and warmer weather these were quickly shed. The costume then consisted only of a tunic ending way above the knees, a loin cloth, and the *kukri*. The Nepalese cap—a sort of uneven fez—was also worn by the majority of the men.

But more important was the land itself. The work of man here was the most incredible I had ever seen. By hand and with only the most primitive tools, the Gurkhas had carved the mountain walls into terrace upon terrace of cultivated fields. There seemed to be nothing in their lives that could be called

easy; every moment represented supreme effort. As the soil is poor, even the greatest effort produces only one crop. Still, though sweat pours from their brows and they are often without sufficient food, they sing and laugh, and man here seems to have found happiness.

My last day in the Himalayas finally came, and it had a prophetic beginning. When I was still asleep, a rooster shot through the window and landed on top of me. There it stood, tense and proud, and from this vantage point it announced the birth of a new day. For me it was a new day—that very morning I found a spring. Never shall I forget the ecstatic feeling of that cool water running down my throat and over my face, my neck, my arms.

It was also on that day that Pokha, out of his meager coins, bought two potatoes and some rock salt from a Gurkha soldier and presented them to me. He knew how hungry I was—when I ate them with relish, his happiness seemed complete.

Back in Kathmandu, mountain climbing again seemed relatively easy. But rough as it was, this trip through the mountains of the Gurkhas will always seem eminently worthwhile because of my inspiring encounter with these wonderful people. In fact, I shall never forget this journey as long as I live; the Gurkhas are not the kind of human beings one can easily forget.



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YOUR NEW BOOKS

continued from page 397

MONT BLANC TO EVEREST ----- by Gaston Rebuffat

Crowell, \$6.95
158 pp., illus.

A PICTURE HISTORY OF MOUNTAINEERING

----- by Ronald W. Clark
Macmillan, \$5.95
350 pp., illus.

Reviewed by
EVELYN AND WILLIAM CROPPER

GASTON REBUFFAT—well known to the climbing world as a Chamonix guide and member of the French Annapurna expedition—has produced a mountaineering book to delight both layman and experienced climber. Half pictorial and half prose, its artistically-put-together text consists of an appreciative sketch of mountaineering history followed by a selection of stories from Rebuffat's own climbing experiences. He takes us to the Alps on climbs throughout the four seasons, and to the Himalaya. His fine dramatic prose provides an eloquent interpretation of mountaineering as both profession and pastime, as an entire way of life. The accompanying photographs are superb. There are climbing scenes

that stir the pulse with drama, mountain portraits that feast the eye with magnificence. The photographs come from many sources, among the best are the author's own.

The climbing described and pictured is of the most extreme sort, with danger close and always apparent. It is remarkable, then, that Rebuffat's mood throughout the book remains reflective and appreciative. He is apparently one of those rare, truly adventurous individuals who has the courage and confidence to live these perilous moments with profound enjoyment.

Another new mountain book is *A Picture History of Mountaineering* by British mountaineer, Ronald W. Clark. This attempts to span mountaineering history from the time of the first known ascents of some minor peaks, through the "Golden Age" of mountaineering when the great summits of the Alps were conquered, to present day climbing activities. The book is profusely illustrated with photographs, some drawings and paintings, and also contains a considerable amount of straightforward factual text.

As a history, this offering is at its best when describing pioneer climbing (largely British) in the Alps; not often does one see a picture collection which conveys a feeling for that splendid era as well as this one does. However, as a general history of mountaineering the book is inadequate. The space given to all kinds of British climbing (including a barn-door traverse in Wales) is disproportionate to the scant, perfunctory attention given to climbing activities in other countries. The book should simply have been titled "A History of British Climbing" of which it is a thorough, if somewhat unimaginative, account.

The reviewers are mountain climbing enthusiasts who are spending the academic year 1956-57 climbing in American and Canadian mountain ranges.

man's origins, the gradual development of culture, the growth of our own civilization, and certain special aspects of human behavior, such as economics, the family, and religion.

There is duplication from one chapter to another that may seem unnecessary; but some of this repetition serves the valuable purpose of emphasizing the fact that all aspects of a culture are intimately connected with one another, so that any division into topics for convenience of discussion will separate things that are nevertheless closely related, such as religion and the family, or invention and economics.

In its balance between topics, and in the sequence of their presentation, this volume is somewhat unsatisfying. Over one-third of its pages are devoted to archeology, with excellent summaries of areas or periods by such scholars as H. L. Movius, Jr. ("The Old Stone Age") and V. Gordon Childe ("The New Stone Age"). This reviewer would have preferred less emphasis, however, on the sequence of particular technological changes and more space for analyses of how the cultures and societies of the world actually function. E. Adamson Hoebel's splendid chapter on "The Nature of Culture" might well have preceded the archeological section, providing a needed transition from the excellent summary of "Human Beginnings" by Harry L. Shapiro that begins the book.

Several chapters are such careful and scholarly summaries that professional anthropologists will find them valuable. Claude Lévi-Strauss writes on "The Family" with great insight, and with numerous helpful ethnographic examples to illustrate his points. The chapter by R. Godfrey Lienhardt, "Religion," is one of the best in the book, presenting a difficult subject without the usual clichés or over-simple explanations. David G. Mandelbaum ("Social Groupings") and Daryl Forde ("Primitive Economics") also make valuable contributions. Perhaps the most interesting presentation of all is the final chapter by Robert Redfield, "How Human Society Operates," which skillfully weaves into a meaningful whole such facets of society as law, warfare, markets, morals, property, and status. With Hoebel's chapter, it provides a good foundation for appreciation of the full importance of details presented by other contributors.

Taken as a whole, this is a remarkably successful survey of the field of anthropology. Its few, and perhaps unavoidable, shortcomings are far outweighed by the excellence of the writing, the clarity of presentation, and the insight gained into why we behave the way we do.

Richard B. Woodbury is the author of many works on anthropology and archeology. He is Associate Professor of Anthropology at Columbia University.

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MAN, CULTURE, AND SOCIETY

----- edited by Harry L. Shapiro

Oxford, \$5.50
380 pp., illus.

Reviewed by RICHARD B. WOODBURY

A readable, authoritative, and up-to-date volume surveying and summarizing any field of the sciences or humanities is always welcome, particularly so for anthropology. Few other fields hold so much fascination for the non-specialist yet have been in such need of general books that avoid the technicality of the monograph, and the dullness of the textbook. In *Man, Culture, and Society*, sixteen authorities write lucidly and systematically with a minimum of technical jargon, about

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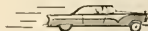
Unforgettably blue and 115 miles long, Lake Mead is the greatest man-made reservoir in the world. It offers swimming, fishing, boating, picnicking and camping in a highly scenic vacationland.

The boy, as a member of a Boys' Club, stands as a monument, too — to the conservation of *human* resources. His club is part of Boys' Clubs of America which this year celebrates its 50th Anniversary. Described by J. Edgar Hoover, a member of the National Board of Directors, as

"a vital institution in the life of our nation," the Boys' Club movement helps more than 400,000 boys to better citizenship through worthwhile activities.

Two monuments to conservation: one, over 700 feet high — the other, less than 5. The men who built the dam can stand back and look at it with pride and satisfaction. But the Boys' Club men who are building tomorrow's citizens can be prouder still — for their handiwork is the hope of America.

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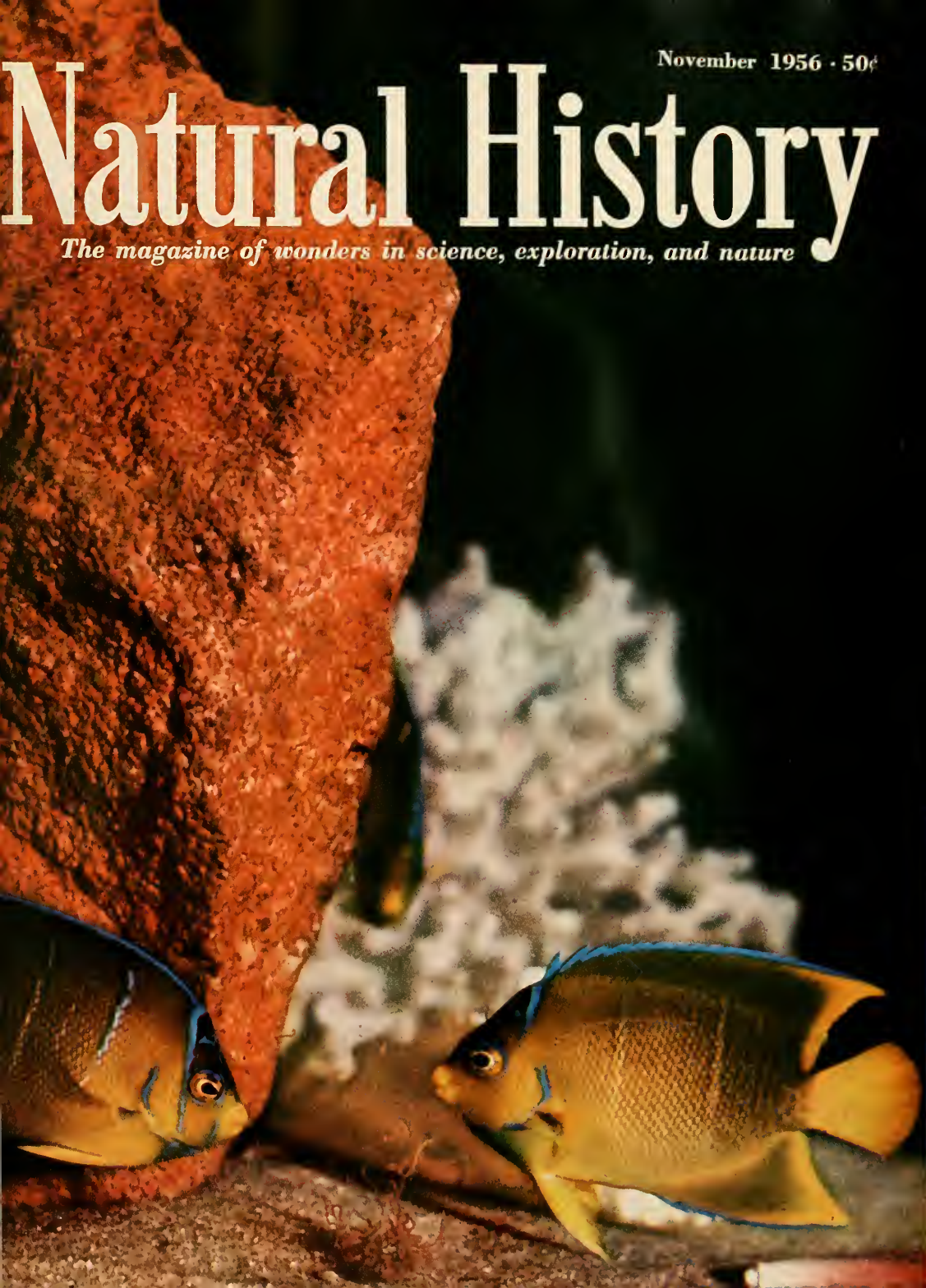
SINCLAIR SALUTES THE BOYS' CLUBS OF AMERICA for their work in building character and developing well-adjusted citizens for tomorrow's world. Under the guidance of National Board Chairman Herbert Hoover, the dedicated adult leaders of these 437 clubs have shown their faith in the quality of youth, in the belief that *a man never stands so tall as when he bends to help a boy*

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Letters

Nighthawk Mystery

SIRS:

Recently, while looking for planes from the top of the courthouse at Brooksville, Florida, a spotter observed a bullbat (nighthawk) that lit on the roof. He observed a large white object in its mandibles. The bird dodged about and emitted the same cries as other bullbats in spite of the object filling its mouth.

The only explanation I could give was that the bird had been disturbed and was seeking a safe place for its egg, and that the egg was an albino. (According to the observer, the egg was pure white).

Is this a possible explanation?

LISA VON BOROWSKY

Florida Audubon Society
Winter Park, Florida

Dean Amadon of the American Museum offers the following comment:

From time to time the assertion is made that certain birds carry their own eggs, one at a time, in their mouths from one nesting place to another. This has apparently never been confirmed for any bird, and even though the nighthawk belongs to a family of birds whose members possess relatively huge mouths that are used in seizing insects in the air, I very much doubt that the nighthawk ever carries its eggs in this way. Furthermore, the egg of this bird is heavily spotted with black, and it would be too much of a coincidence to believe that something which occurs rarely, if at all, also involved a rare "albino" egg.

The first reference I consulted on the habits of the nighthawk mentions a case in which one of these birds was observed catching white moths which had gathered about a drainpipe on a roof. Nighthawks often nest on flat gravel roofs, and the bird in question may well have been carrying a white moth or butterfly in its bill.

When Niagara Stood Still

SIRS:

The article in your September issue titled, "When Niagara Stood Still" is one of the most fascinating pieces I have ever read. The phenomenon itself is extremely interesting. Your author added to the interest by his excellent description of the uncertainty, confusion, and awe that the phenomenon caused.

The story raised one question in my mind: It tells of news spreading so rapidly that, "By noon there were 5,000 on-lookers from as far away as 50 miles." There were cameras in existence in those days, and I cannot help wondering if somebody did not photograph the dry falls. Yet, your article used a pen drawing to show what actually occurred. Perhaps one of your readers will come forth with a photograph of the phenomenon. If so,



▲ AN IMPRESSIVE PORTRAYAL of protective instinct and timidity in the mandrill family.

I hope you will reproduce it in *NATURAL HISTORY*.

TED LEITZELL

Chicago, Ill.

We have not been able to locate one as yet.—Ed.

Humming Courtship

SIRS:

Your correspondent asked in the September issue about the peculiar buzzing and trilling of hummingbirds while engaging in short, vertical spurts of flight. In answering this enquiry, territorial defense and courtship were given as possible explanations. May I say that in the instances I have seen, I am inclined to support the wooing theory. Year after year, the clothesline back of my studio has been an open setting for these demonstrations. The arc flights were accompanied by an explosive chirp at the lowest point of the swing immediately over the head of the

perched female. The demure little bird acknowledged these gallant gestures by locust-like squeaks, and if a rival appeared, the aggressive little male would dart after him and then apparently return to his courtship.

MABEL MURRAY RICHARDSON
San Marino, Calif.

Fencing Around

SIRS:

I have five bantam chickens that often dig out some of my mother's prized plants. My mother says we'll have to pen them up, and my dad says we'll have to give them away. Could you suggest a method to keep them away from the plants?

REX A. COUTURE

Seattle, Wash.

One of the country's leading experts on animal behavior says to fence the plants in or regularly dust them copiously with red pepper—kerchoo!

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AUTUMN ACROSS AMERICA ----- by Edwin Way Teale

Dodd, Mead, \$5.75
386 pp., photographs

Reviewed by ROGER TORY PETERSON

IN 1947, Edwin Way Teale explored a new field, the natural history of a season. Accompanied by his wife, he followed spring in the East from the southern tip of Florida to the Canadian border, and his report, *North with the Spring*, published in 1951, immediately became a best seller. It was inevitable that this book, which may well be regarded as a classic, should be the first of a foursome on America's changing seasons. I had wondered how he would handle the next installment. Would it be "South With Autumn?" Instead he chose to go west, cutting across the season from the Atlantic to the Pacific. The superlatively good product of his latest odyssey is *Autumn Across America*.

Starting at Monomoy on Cape Cod at the time the shorebirds gave the first intimation that summer was blending into fall, he proceeded down the coast as far as that bottleneck for birds, Cape May, before turning inland to the Pennsylvania ridges and the broad flat country beyond. Monarch butterflies, southbound, were encountered from coast to coast—at Monomoy, Cape May, Point Pelee, on the prairies, even midway across the vast salt flats of Utah, and finally at their fabulous wintering roost at Pacific Grove in California.

Spring is universally the season of life and rebirth. Fall brings mixed emotions. To some, October is the season when health and vitality are at their peak, the countryside at its most colorful. Others, like Thomas Hardy, insist that even in the loveliest autumn days "there is death in the air." Only once did this wave of autumn sadness envelope Edwin Teale, and that was when he revisited the Illinois countryside of his childhood and saw the old pond, now blighted, and other changes. He wrote: "Nature—absorbed with species and averages, not with individuals—cares but little whether these birds return again. All the insects singing in the grass, all the leaves still spread to the sunshine, all the dusty annuals and the waving flowers—they were all living their last days and the end was moving swiftly toward them. Life would come again in the spring—but not this life, not to these flowers, not to these leaves, not to these crickets and grasshoppers."



▲ Author, Edwin Way Teale, takes a break.

But this somber mood comes to the surface only once or twice in all the 386 pages. For Teale is always vital, always interested in everything that grows, crawls, walks, swims, or flies. And, perhaps more than any other nature writer today, he has the skill to make even the most blasé reader almost as interested in the least bug as in the more spectacular wildlife.

The three most striking manifestations of fall—harvest and fulfillment, the migration of birds, and the color changes in leaves—are described artfully and explained with ingenious skill, but this book is more than a series of essays on the fall season; it is also a travel book, taking us through the heart country where James Fisher, my British colleague, and I failed to go when we made our tour around the perimeter of *Wild America*.

✓ In *Autumn Across America* we are taken on a skin-diving adventure off the end of Long Island, down the hawkways of Pennsylvania in a light plane, into the heavens by means of a comet-hunter's telescope, down a north-Michigan river by canoe, up the Mississippi to its source, into the Dakota badlands by moonlight, over the high Rockies at high autumn, down into the Bear River delta when a million ducks are present, over to the Olympics "the land of the windy rain," and south with the waning season to California, where the 20,000-mile trip terminates at the edge of the surf where sea otters play. Forty-nine photographs of exhibition quality enhance the book.

Don't miss this salute to autumn. It is Edwin Way Teale at his best.

The most recent work of Roger Tory Peterson, the well-known naturalist, is Wild America (1955).

THE SEARCH BENEATH THE SEA

----- By J. L. B. Smith

Henry Holt, \$3.95
272 pp., illus.

Reviewed by BOBB SCHAEFFER

ONE of the most fascinating episodes in the annals of natural history began on December 22, 1938, some three miles off the coast of South Africa, opposite the mouth of the Chalumna River. Here a small fishing trawler hauled aboard a very strange fish which neither the crew nor the captain could identify. When the vessel docked at the near-by port of East London, the almost five-foot specimen was shown to Miss M. Courtenay Latimer, Curator of the small East London Museum. Its curious lobed fins, distinctive tail, and heavy scales were new to Miss Latimer. She wrote immediately to Professor J. L. B. Smith, an ichthyologist associated with Rhodes University, enclosing a sketch and brief description. Hardly able to believe what he saw and read, Professor Smith hesitatingly identified the creature as a coelacanth—a living representative of a group of fishes long regarded by paleontologists as extinct for 75 million years! When five weeks later he finally saw the stuffed and mounted specimen he definitely identified it as a coelacanth, which he subsequently named *Latimeria chalumnae*.

This first chapter in the saga of the coelacanth is graphically described in Professor's Smith's frequently emotional, and self-revealing book. His obsession to find a second specimen and his final success provide the reader with an engrossing account of constant planning, frustration, and renewed hope. Smith traveled extensively up and down the east coast of Africa, talking with fishermen and distributing leaflets about *Latimeria*. It was not until December, 1952, that all this effort paid off. A cable from a trawler captain in the Comoro Islands, which are northwest of Madagascar and 1800 miles from East London, announced the capture of a second specimen. With no known French scientist in the area, Smith was desperate for assistance to retrieve the specimen. He finally approached Prime Minister Malan directly and obtained a military aircraft for the flight to the Comoro Islands. Because of apparent differences from *Latimeria*, it was named *Malania*.

In September, 1953, a third specimen was caught in the Comoro Islands, and this one, in perfect condition, was sent to the Research Institute in Madagascar. Although Smith remained intensely interested in the coelacanths, he finally relinquished the study to the French, who obviously were in a better position to obtain good specimens. Since that time nine more coelacanths, including two females, have been obtained from the same area. All the French specimens are

▼ J. L. B. SMITH, a few moments after the second coelacanth was identified in December, 1952.



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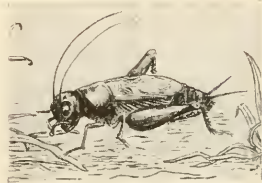
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now in Paris, where they are being investigated in great detail by Professor Jacques Millot and Dr. Jean Anthony.

Firsthand accounts of important discoveries in science are nearly always more exciting and more real than the interpretations that follow. Those who enjoy sharing in such discoveries will find this book of absorbing interest. It is as much the story of a man's reaction to a great task suddenly thrust upon him, as it is the story of the first two living coelacanths seen by man.

Much has been written about the coelacanths in the popular press, and a few rather general misconceptions need to be corrected. The coelacanths are a very distinctive group of lobe-finned fishes. They are most closely related to another group of lobe-finned fishes called rhinidistians, which existed from the Devonian to the Permian period. The rhinidistians gave rise to the first vertebrates with true limbs, the amphibians. The coelacanths, with a separate history also extending from the Devonian period, have remained practically unchanged for over 300 million years. Inhabiting a wide variety of marine and fresh-water environments during their long career, they probably were restricted to the continental shelves about 75 million years ago. Today one genus, *Latimeria*, remains (*Latimeria* is a multilated *Latimeria*), and it is known to occur only in one small part of the Indian Ocean.

One of the country's leading experts on fossil fishes, the reviewer is Curator of Fossil Fishes at the American Museum of Natural History.

THE EARTH BENEATH US

- - - - - by H. H. Swinnerton

Little, Brown, \$5.00
335 pp., illus.

Reviewed by H. E. Vokes

THE English seem to possess special ability in the preparation of popular scientific works; *The Earth Beneath Us* is a valuable addition to the select company of such works in the geological sciences. The author, Professor Emeritus of Geology at the University of Nottingham, brings to the preparation of the book a lifetime of teaching and research in the science.

The Earth Beneath Us is divided into six parts: "The Origin of the Earth," "The Face of the Earth," "The Realms of Pluto," "The Climates of the Past," "The Procession of Life," "The Coming of Man." Each part is in itself worthy of book-length treatment. This reviewer's principal criticism of the work arises from the fact that Professor Swinnerton, in his effort to encompass so much in a single volume, has had to give but barest men-

tion to many topics that are of much interest to the average layman and geologist, and topics that are entirely worthy of mention have had to be wholly omitted.

The broad knowledge of the author insures the scientific accuracy of the work. It came as something of a shock, therefore, to find that Death Valley is said "to owe its evil name and reputation to the presence of outlets of this gas [carbon dioxide from ancient volcanic vents], which, because it is heavier than air, lingers along the floor of the valley."

This book is recommended to all interested in the story of the earth and its history. Concisely written, the text is clear and always interesting. Teen-age and adult readers will enjoy it.

The reviewer, Professor of Geology at Tulane University, has written widely on his subject.

HIGH, WIDE AND LONESOME

- - - - - By Hal Borland

Lippincott, \$3.75
251 pp., illus.

Reviewed by EDWIN WAY TEALE

IT WAS the belief of the noted American editor, Maxwell Perkins, that the best writing is done about events long after they have occurred. *High, Wide and Lonesome*, Hal Borland's recollections of his boyhood on a homestead amid the lofty, rolling prairie land of eastern Colorado in the early years of the present century, offers additional proof of the Perkins theory. The book is simply and beautifully written. Woven from the indelible memories of childhood, it brings vividly to life the people, the setting, and the wild creatures of one of the last frontiers of the homesteading era.

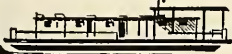
Hal Borland, now a distinguished writer on the out-of-doors and contributor of weekly nature essays to the Sunday editorial page of *The New York Times*, was eight years old when his printer father moved west from Nebraska to homestead 320 dry acres in the rain shadow of the Rockies in northeastern Colorado. That was in the spring of 1909. The open range was just giving way to the fenced farms of the first homesteaders and all around were wild creatures that had lived on the prairies "forever." They—the jack-rabbits, the kit foxes, the horned larks, the prairie chickens, the harvester ants, the coyotes, the prairie dogs—play an important part in Borland's book. All outdoors, to his young eyes, seemed one vast, wonderful zoo. Periodic visits to a neighboring prairie dog village had for him all the excitement that a trip to Concy Island has for a city child. This feeling of adventure and delight he has captured

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in his book. He has also captured some-
thing of the sense of transformation from
boy to man, the growing up to responsi-
bility and maturity that featured the
memorable last pages of Marjorie Kinnan
Rawlings' *The Yearling*.

For the grim side of homesteading was
never far below the surface. It was a
battle against elemental enemies: hunger
and sickness and cold and drought. Cattle
destroyed the first cornfields. Work horses
died from eating the treacherous "death
cassia" of the high prairies. Typhoid
fever struck. The boy was lost in a sudden
blizzard and saved only by the wisdom
of his horse. In the land around the Bor-
land homestead there was a constant ebb
and flow of other settlers—the new ones
arriving, the discouraged and defeated
leaving. Lasting long enough to win title
to the land became the great goal. This
thread runs through the book as it did
through the life of those pioneer times.
The reader shares it, is exhilarated by it.

In those days when half a section of
land could be obtained from the govern-
ment merely by living on it for four years,
a motley collection of settlers was drawn
to Colorado. There were the "wild Walk-
ers" with their pack of thieving children
ranging over the countryside on horse-
back. There was the cultured couple who
journeyed from Illinois bringing a library
of classic books along. There was the
brutalized German from Cincinnati who
spent his days in sadistic abuse of his
animals and who, in an almost too-appro-
priate retribution, met his end in a kind
of Greek-tragedy climax. They, like the
shepherd with his preposterous stories
of dietary eccentricities and the grim old
cattleman, bitterly watching the open
range shrink year by year, come sharply
into focus.

Aside from its considerable material on
natural history, its human interest, its
picture of the high prairies and the crea-
tures that inhabited them, such a volume
has special value as a record of the life
lived on the western frontier. It is a real
contribution to the annals of this period.

*Burroughs Medal winner (1943) and au-
thor of many books on natural history
since Grassroot Jungle (1937), Edwin Way
Teale is an outstanding interpreter of
natural sciences for the layman.*

WINDOW IN THE SEA

----- by Ralph Nading Hill

Rinehart, \$3.50
208 pp., illus.

Reviewed by GERARD PIEL

SHORT of a motor trip down the Atlan-
tic Coast to Marineland, Florida, this
book is the pleasantest way to visit Marine
Studios, the oceanarium operated there.
As 700,000 annual visitors have come to

continued on page 504

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Each plant bears only a single stem of fruit

IN FROM SEVEN TO TEN MONTHS after planting, the first flower stalk grows up through the hollow stem.



duced. After 7 to 10 months, the first flower stalk grows up through the hollow stem, while at the same time the rootstock enlarges and accumulates a great amount of starch."

"What good is the starch?" I asked.

"The starch is stored-up energy that enables fresh plants to get started," Mr. Copper went on to explain. "After a banana plant has given up its fruit, it is cut down and a shoot grows up from the base. This will develop into a new plant, ready to be harvested in a year. Or bits can be cut from the rhizome of the old plant and used to start other plantations."

I looked at the banana trees with more respect. "But where did the roots come from originally?" I asked. Now that I'd started to be a nuisance, I was determined to get the whole story.

"Originally," said Mr. Copper, "they came from far, far away. I suppose you've heard of Fra Berlanga."

I tried to look intelligent, although the name meant nothing to me.

Mr. Copper is a very nice man. "As you know," he said tactfully, "the Reverend Tomás de Berlanga was a famous Spanish priest. In 1516 he left the Canary Islands and came to Santo Domingo as a missionary, bringing a few banana roots with him, and that was how the fruit was first introduced to the New World. Of course the history of the banana goes back much further. Bananas were originally encountered by the armies of Alexander the Great in India as far back as 300 B.C. and were doubtless growing there centuries earlier.

From tropical Asia, the plant was taken to the eastern coast of Africa and from there probably carried westward to the Guinea Coast by the early Arabs who were great traders. When Portuguese explorers discovered the Guinea Coast in 1482, they brought the plant and its African name "banana" to the Canary Islands. And thus we get back to Fra Berlanga." Mr. Copper looked anxiously at his watch. "Time for lunch," he said relievedly, and it was clear the history lesson was over and school was out for the day.

Armando, our favorite of the four workmen whom we had employed to do the heavy digging and who had lived in Palmar all his life, added his bit to the picture. "I can remember as a child," he said, "when THEY first came here." "THEY" represented the Fruit Company and Armando always used the word with awe, as if it were capitalized. "When they came, they cleared away all that stuff. It was a terrible job but they did it."

"What stuff?" I asked him.

Armando flailed his arms about wildly but was unable to be more specific. "He means the underbrush," interpreted Sam, who is better at understanding sign language than I am. "This country must have been impenetrable jungle."

"Then they planted those funny little bits in the ground," Armando went on, "and afterwards they chopped down the trees."

"THEY must have chopped the trees down first," I corrected him, finding myself unconsciously treating the Fruit Company with the same awed respect Armando did.



"Otherwise the trees would have smothered the plants," I added.

"Afterwards," Armando insisted stubbornly. I was sure he was wrong, but he refused to change his story, so I checked with Mr. Copper, who by then was probably sorry the Lothrop had ever appeared in Palmar.

"He's quite right," Mr. Copper told me. "First the underbrush was cleared away, then the banana roots were planted and some time later the timber was felled."

"But why later?" I asked, deflated. "Wouldn't the fallen logs crush or smother the banana plants?"

Mr. Copper shook his head. "The plants grow up around the logs, which eventually rot and enrich the ground. And that's very important."

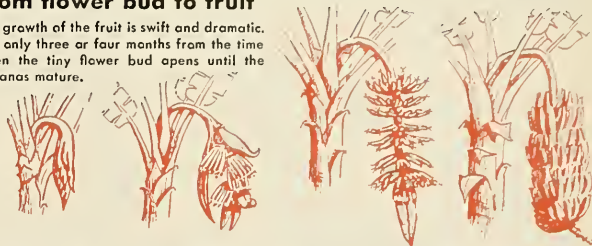
"Then banana cultivation isn't so complicated after all," I teased him. "Once you've cleared your ground and planted your banana roots, things work by themselves. The plants regrow, the trees decay and enrich the soil and all you have



United Fruit Company

From flower bud to fruit

The growth of the fruit is swift and dramatic. It is only three or four months from the time when the tiny flower bud opens until the bananas mature.



As the stem lengthens, the bud turns downward.

Groups of flowers are exposed as the bud opens.

Each group of flowers becomes a hand of bananas.

Growing plump, the bananas turn upward. The bud remains at the tip.



to do is sit back and let nature do the job."

"That's only the beginning," said Mr. Copper. "You have no idea..."

I had no idea, but after a few months I learned, mostly at first hand.

We used to work every day on one farm or another, digging in between the banana trees, and I became very much interested in the particular ones in our vicinity. Each plant was under the surveillance of the Fruit Company and, in order not to interfere with their periodic attentions to their precious charges, we kept various digs going at the same time and when necessary switched from one to the other. As bananas can be planted in any month of the year and thus mature at different times, the growth on different farms varied and we therefore had a good opportunity to watch the progressive stages of development.

The changes seemed swift and dramatic. One day we would see nothing more than a tall plant or tree with a dozen or more long



▲ PLANTING BANANA "BITS," sections of the underground stem or rhizome of a banana plant that has lived its life.



▲ THIS CROSS SECTION and the vertical section at right show the enfolded leaves and the central pulpy part of the "trunk."



green leaves waving in the breeze (in case we were lucky enough to have a breeze). A few days later the stem which would eventually bear the fruit had suddenly appeared through the center of the stalk, the tiny flower bud at its end looking like an ear of corn in its husk. In no time at all, or so it seemed, the husk, or bracts, had dropped off and the stem was bent over; above it, a bunch of baby bananas pointed downward. And then, for some reason that defies logic and the law of gravity, the bananas as they got bigger gradually pointed outward and then upward, from then on growing upside-down.

The bud is fat and purply-red and hangs from the drooping stem, looking somewhat like an eggplant elongated at the bottom. Its fate is a sad one, for after it has grown to full beauty and maturity, it is knocked off and left to rot on the ground.

The first time I witnessed this procedure I was outraged, for it was only later that I learned that the bud, if not removed, takes away nourishment from the bana-

nas. We had been digging for hours without finding anything more interesting than a few pieces of broken pottery, when my attention wandered and I noted a fierce-looking little man ambling in and out of the banana trees with a long pole to which a crescent-shaped knife was attached. He was peering up at the trees, and apparently whenever it suited his fancy he would idly raise his pole and lop off a banana bud. "Sam," I said excitedly, "look what that dreadful man is doing. We've got to stop him."

Sam reluctantly removed his eyes from the pottery and regarded the native. "None of our business," he said shortly and returned to his examination.

"You're a coward," I protested. I was shocked at his indifference. After all, we were guests of the Fruit Company and I felt we owed it to them to prevent what was obviously a case of vandalism. So, although I was trembling, I walked up to the delinquent and said, "What are you doing here?"

He gave me a nasty look. "What are you doing here?" he countered.



"We are working with the permission of the Fruit Company," I said haughtily.

He laughed. "So am I," he said. "I'm the bud man."

"You're the what?"

"The bud man," he repeated. "Juan Larco. I knock off the buds." He lifted his pole and expertly sliced off a bud, which fell at our feet. "Ever tasted one?" he asked. "The heart tastes like a nut." He quickly peeled off the outside leaves and extracted a white kernel, which he pared down with his machete until it was about the size of a strawberry. "Here," he said,



◀ EACH SPRAYER irrigates over three acres. The sprayer takes 15 to 20 minutes to revolve.

▼ PROTECTING the plants from leaf spot-disease with Bordeaux mixture.



handing it to me. "Eat."

I didn't dare refuse, so I broke off a piece and took a gingerly bite. To my surprise the bud was crisp and tasty.

Juan Larco stood and watched me, on his face the same mixture of anxiety and pride as that of a headwaiter who has just prepared a dish of crêpes suzettes. "You like?" he finally asked.

"Delicious," I said, and Juan beamed. "I'll be in this neighborhood tomorrow," he said, "and prepare you another."

"What else do you do besides knock off buds?" I asked him.



▲ THE CUTTER notches the plant near the top with a crescent-shaped knife, causing the bananas to bend down. He then guides the load onto the shoulders of the "backer" and severs it with a machete.



▲ CARRYING bananas to the washing spot on donkey back.

▼ WASHING the fruit by the hand method. Sometimes a conveyor is employed.



"What else?" he repeated. "Why nothing, I'm the bud man."

"And you go around day after day on that one job?"

"It is sometimes a little monotonous," he admitted. "But the pay is good."

For the first time, I got an idea of the magnitude of the operations involved in running a banana plantation, when I realized that the Fruit Company employed a man to do nothing but lop off buds at the proper time.

Most of the native employees had been trained to do specific jobs, and there seemed to be some-

thing going on all the time. This made life considerably more amusing than it would otherwise have been. There were periods in our digging when nothing at all turned up, and at such times, I was always able to watch what went on in the banana world.

There were the men who propped up the banana trees. With the improved methods of banana cultivation, the fruit has grown bigger and heavier, so that in many cases the tree is not strong enough to hold it and tends to fall over. When this seemed likely to occur, the tree was propped up, sometimes

with a giant bamboo pole, sometimes with a long steel tube.

There was the irrigation, which was a regular procedure. A series of huge towers and an elaborate system of overhead pipes covered the entire plantation, and during the dry season, which lasts roughly from January until May, the banana trees were watered on a specific day each week, the day varying on different farms.

The watering system was very ingenious. There was one tower for each 3.3 acres of land, and enormous Diesel engines forced the water through pipes to a nozzle at



◀ A TRAINLOAD of bananas has just reached Golfito, and the workers are loading the bunches on a revolving conveyor, which deposits them in the ship's hold.

▼ AN AIRPLANE VIEW of a United Fruit Company ship taking on a cargo of bananas at Golfito. The laborers' houses are seen in the background.

United Fruit Company



the top of the towers, through which the main stream shot into the air, blanketing everything in the vicinity. On the side of each nozzle, which was pierced by a tiny hole, was attached a small wheel, and water, escaping through the hole, caused the wheel and then the nozzle to revolve slowly, thus changing the direction of the sprinkling and guaranteeing each banana tree its weekly supply of liquid.

The irrigation always seemed to take place on those occasions when we had uncovered something interesting. Time and time again we would sink a pit and find some unusual archeology—brightly painted pots or stone statues perhaps—only to have to make a mad dash with our photographic equipment to escape the approaching shower or to find our objects reposing in a sea of mud.

There was the spraying against banana blight, which took place every week on the day following the irrigation. The pipes through which the spray was driven were close to the ground, with nozzles placed at regular intervals. To these, workmen attached 175-foot rubber hoses which they dragged back and forth, periodically changing them from one nozzle to another, until each banana tree was sprayed on every side.

The men who did the spraying were supervised, albeit rather casually, and chances for cheating were slim. The spray, called Bordeaux mixture, turned everything a whitish-blue—the trees, the ground, the men themselves—and if even one banana retained its original color, the workman responsible for it was out of luck.

The residue from the spray lasted for days, and Sam and I were apt to go home looking like Indians about to perform a war dance, our clothes and even our faces streaked whitish-blue, at times interspersed with bright green from the nitrate, which was regularly spread on the ground to nourish the trees.

Then there was the cutting gang, who might turn up at any time. Their operations never failed to fascinate me. Each gang consisted of three men—the cutter, who decided which bunches of bananas were ready to be picked, and two

backers, who managed the load.

The cutter was the man in charge, and his job was an important one. Bananas are never allowed to ripen on the plant. They are picked when green and must be green when they arrive at their destination. To the untrained eye, one green banana looks just like any other green banana, but actually there is a distinct difference in the degree of maturity (or immaturity), and unless the bunch is cut down at precisely the right time, it may begin to ripen before it should. Thus bananas to be transported to England were gathered in a greener condition than those for the United States, as the time they would spend en route was almost double.

The cutter, then, started by pointing to his choice, after which one of the backers would remove the prop that held up the "tree." The cutter, using a knife on the end of a long pole, would then

continued on page 500



E. A. Reimer

▲ WARREN HAMAKER, center, has brought up 141 ancient stone pieces from an area about 15 x 20 feet. At low tide, the mortars are from 9 to 12 feet below the surface.

Mystery Mortars UNDER THE SEA

Venturesome divers have found them by the hundreds at a few concentrated points, but not a single grinding stone has been found to go with them. Were they left by prehistoric man when the sea was lower?

By MARGARET THORNBURGH

WINTER currents along the coast of southern California are temperamental. Sometimes they uncover pockets that may have been buried for years under thick layers of sand.

The year 1951 brought unusual scouring by the currents, and one

February afternoon an extraordinary archeological discovery was made in the cold Pacific waters off Solana Beach. Swimming about in the weird half-light, nine to twelve feet down, two young skin divers were searching for the succulent abalone and lobster. Among the

ocean-rounded stones on the bottom a rock that looked "different, like a doughnut" was noted. When they brought it to the surface, they found that it was an Indian mortar or grinding stone. Sand in the hollowed-out center had made the round rim conspicuously different



from the surrounding cobblestones.

How did this mortar happen to be in the sea? Could there be more such relics down there?

One of the divers, seventeen-year-old Warren Hamaker, went back to find out. In fact, he returned again and again when there were favorable low tides and finally brought in a total of 141 pieces! Some of them were granite, but the great majority were sandstone. All the mortars were about the same size, six to eight inches or so across, and *all* were found in a small, well-defined area no more than 15 by 20 feet, in a sharp "little bay" in the rock bottom.

The great abundance of the stones only heightened the mystery. Never had such a concentration of this type of mortars been found, even on land.

In September of that same year, some boys diving just off La Jolla,

fifteen miles to the south, found a rock that looked strange to them. They took it to A. A. Allanson, field archeologist and expert diver, who recognized it as a broken piece of a mortar. He, too, was curious, and he began an extensive underwater search between the beach and the great submarine canyon that begins less than a half mile from shore. In the months and years since, he has recovered 275 pieces from newly bared and usually temporary troughs and pockets of this limited territory. With what other divers from near-by Scripps Institution of Oceanography have brought in, the total number of artifacts has reached over 600.

Although the collections include several net weights, handstones, and metates, and four pestles large enough to be used with mortars weighing 35 or 40 pounds, most of the pieces are small mortars—to all

appearances identical with those found at Solana Beach.

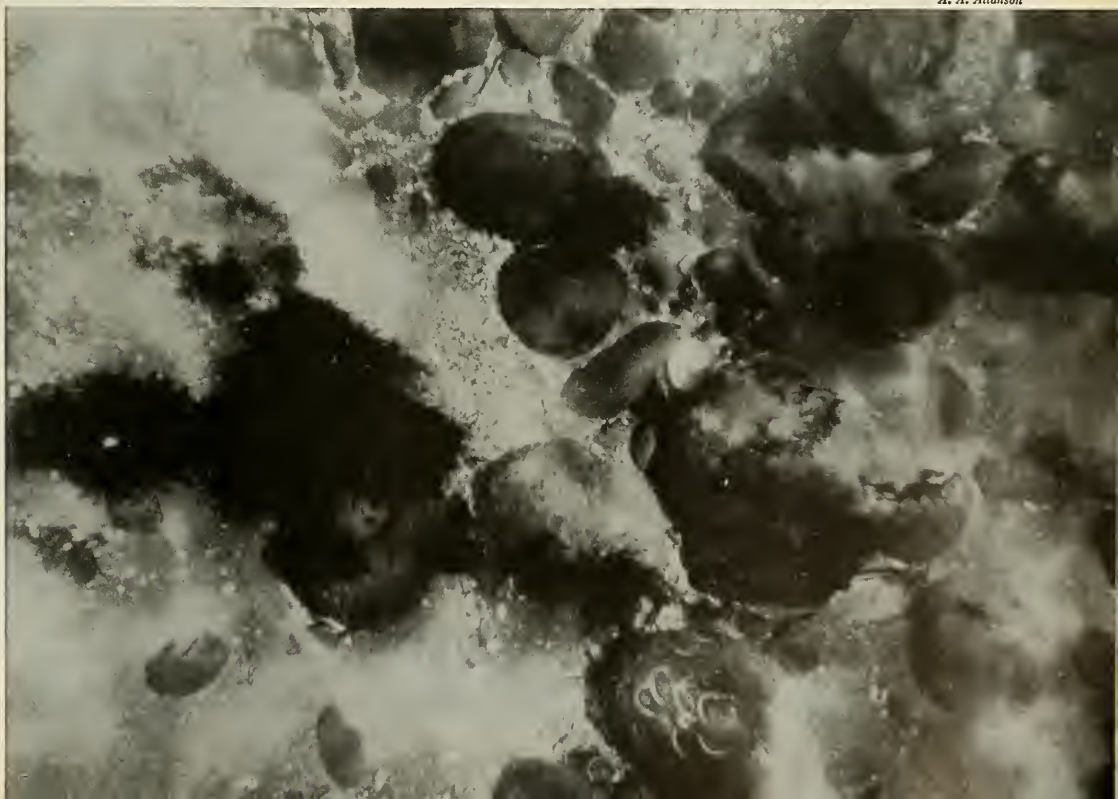
Where did they come from? In what faraway times were they shaped and used? Everyone who sees these artifacts, some with shells attached and ornamented with curls and wisps of grassy sea growth, speculates about their origin. That ancient pieces should be found so far below the present shore line is a challenge to scientists.

Were the stones moved, somehow, by natural forces? Or do they lie where prehistoric people left them? Did the sea level rise or the land level sink? Did men deliberately drop them into the sea? And *why* has not a single small pestle been found to go with these hundreds of mortars?

"You'd think we'd find *one* pestle of that size, locked in the rocks with some of these mortars," says Al Allanson. As a skilled observer,

▼ A TYPICAL SECTION OF OCEAN FLOOR, near La Jolla, California, where many of the mortars have been found. Even when the scouring currents expose them, they are difficult to distinguish, because they often lie with the rounded bottom up.

A. A. Allanson



➤ ONE OF THE BETTER-MADE MORTARS shown in actual size. It was recovered off La Jolla by Mr. Allanson, whose collection contains 275 pieces.



▲ EXPERT DIVER AND FIELD ARCHEOLOGIST A. A. Allanson, cataloguing mortars brought up from the sea floor. "You'd think we'd find *one* pestle of the right size, locked in the rocks with some of these mortars," he says. "But we haven't."



A. A. Allanson

thoroughly familiar with the ocean floor in this section and with the archeology of southern California, he would certainly have recognized such artifacts if they had been present.

What was their use?

What were these mortars used for? They are small for grinding acorns. For grinding seeds, perhaps? Some are worn nearly through, indicating long use. Others show no signs of wear.

Could they have had a ceremonial purpose? The well-known archeologist Mark R. Harrington thinks that they did but admits it would be hard to prove. The ceremonial use of mortars, particularly in the initiation rites of young men, has been recorded for tribes in the San Diego County area.

The great concentration of mortars at the two sites encourages the idea that these may have been special spots for sacrifice or other

religious observance. A primitive fisherman might make it a practice to drop a mortar from his craft at a particular spot as a gift to the sea gods—a bribe to the waters, perhaps—as he started his quest for food. Or it might have been a custom at the time of a person's death to drop mortars into the ocean, instead of breaking the funeral offerings as was the custom among many tribes.

Mortars are generally associated only with the later cultures, approximately within the last 2,000 years, but there is still much to be learned about the archeology of this coast—even about the age of mortars.

Changing shore lines may have put the mortars underwater. Although the great glaciers of the Ice Age did not reach southern California, they affected it just the same. A great quantity of water was locked in the ice cap, and as a consequence the level of all the oceans of the world was considerably lower than it is today. In the Ice Age, the rivers

emptied into the sea well below their modern levels.

Dr. George F. Carter of Johns Hopkins University had long predicted that some day just such underwater artifacts would be found. More than 25 years of work in the archeology of this San Diego County area convinced him that the remains of ancient cultures were buried deep in the offshore river deposits. Primitive man liked to live near his source of food; here this would put him close to the edge of the sea. If the beaches were lower than those of today, melting of the great glaciers would have flooded them. As the sea rose, the people would have had to move inland through the centuries, and remnants of previous sea-coast cultures would be submerged under water and silt.

In more recent times, the pounding waves could have uncovered the ancient deposits. "Man *was* in America 10,000 years ago," says Dr. Carter. "It is certain that habitation sites



▲ NET WEIGHTS like this have been recovered, but they pose less of a problem, because they could have been dropped by fishermen.

A. A. Allanson

occur beneath modern sea levels. Some of the material found at La Jolla and in adjacent California quite certainly reflect these facts."

Metates—flattish grinding stones—belong to older cultures than the mortars, and it may be significant that a metate was found with the material deepest and farthest out, in about a hundred feet of water and at the edge of the La Jolla submarine canyon.

Pecking marks still visible

That the mortars have not been moved far by ocean currents is strongly indicated by the "pecking marks" plainly in evidence on many of them. These are slight indentations in the surface, made when the rough bowl was shaped by the blows of a harder stone. The same conclusion is suggested by the sheen or polish on some of the *manos*, or handstones. Also, the sandstone mortars would have broken if they had been subjected to much rolling



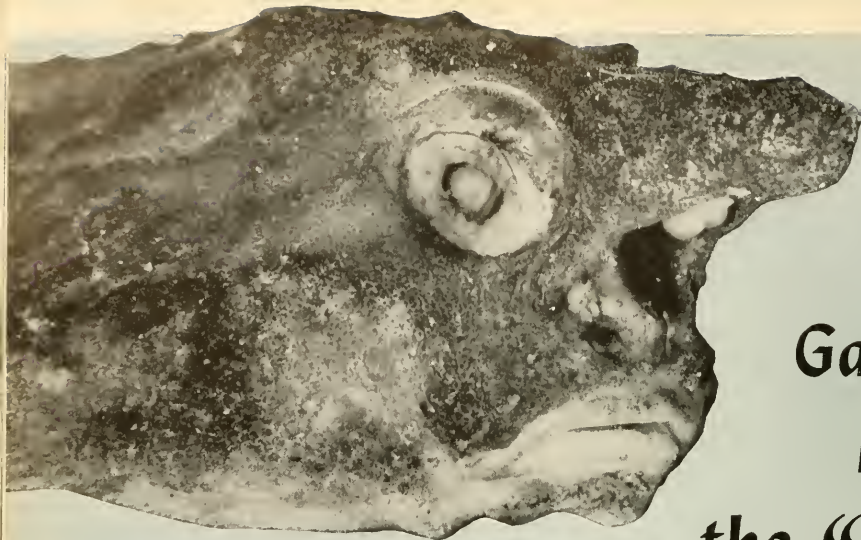
▲ PART OF A. A. ALLANSON'S COLLECTION. Most of them are sandstone; a few are granite. The fact that they could not have survived much battering by the surf suggests that they have been covered by earth or sand during much of the intervening centuries.

and battering in the surf zone.

With divers alerted, a few additional pieces have been discovered since 1951 at various locations up and down the coast. Several have been brought up at other spots off La Jolla, and one off Imperial Beach. One was found by a commercial abalone diver in 60 feet of water off Point Loma. But in their extraordinary concentration, the original

finds at Solana Beach and La Jolla are unique.

Undoubtedly more of the ancient pieces will be discovered. And as additional evidence of the culture of prehistoric man along this southern California coast comes to light, we may hope to fathom the mystery of the mortars—their origin, their antiquity, and their surprising concentration.



▲ THE CREATURE is grotesque from any angle, but this view reminds almost everyone of someone they know.

Galápagos Produces the “Thing”

A grotesque member of the batfish family, unknown until a few years ago, will soon be given a scientific name by Dr. Carl L. Hubbs of Scripps Institution of Oceanography

By WILLIAM E. LUNDY

A RUMOR reached me at my office in Balboa, Canal Zone, that a fishing boat had just arrived from the Galápagos Islands, bringing with it a creature stranger than any of the exotic forms of life for which these islands are noted. I was soon aboard a tuna clipper gazing in amazement at a strange sight. The weird, dark brown “Thing” — seemingly a combination of animal-fish or fish-animal — might well have been a creature from an unknown world!

From a seven-inch body, two arm-like growths, “hinged” where they joined the “chest”, protruded at right angles, while what appeared to be well defined and jointed “hind legs” flared from the sides, ending in fin-like webs. A huge “proboscis” stuck out from the “forehead” and accounted for one-twelfth of the total length of the creature. To all this was added the tail of a fish!

“Twenty years I fish those waters,”

said its captor, “twenty years, and these” indicating other members of the crew with a sweep of his arm, “some twenty years, some more, and never any of us see one like this!

“We fish along the coast of Isabela [Albemarle]—one of the Galápagos Islands, you know—usin’ a bait net. It lay flat on the bottom. We send divers down so it don’t get hung on rocks. How deep? Oh, maybe two an’ a half, maybe three fathoms.

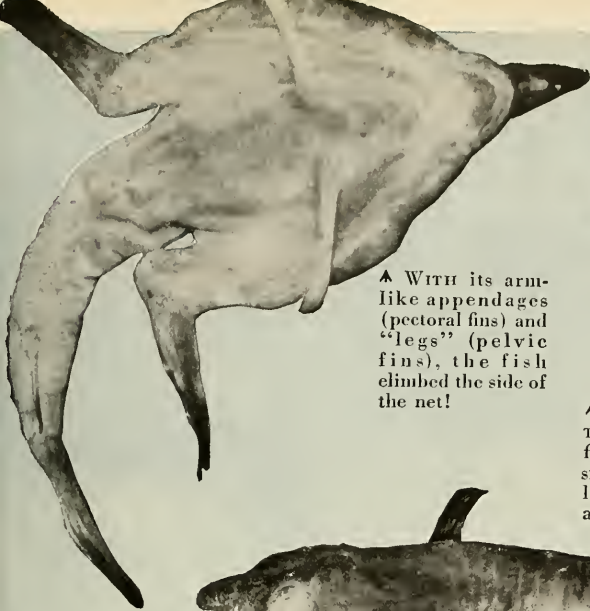
“I look into one just pulled up and see a funny little snout stick out at the edge of the net. Seem to look straight at me. I wave my hand at it an’ down it go. I watch it *climb* the side of the net a little further away. Once more I wave my hand an’ down it go again. I watch it. It *don’t swim*; the tail don’t move; it *hunch* along up the side of the net. It use those little arm an’ leg looking things, like this. . . .” He demonstrated by hunching one and then

the other shoulder upwards, as a man’s shoulders would do if he were climbing hand-over-hand.

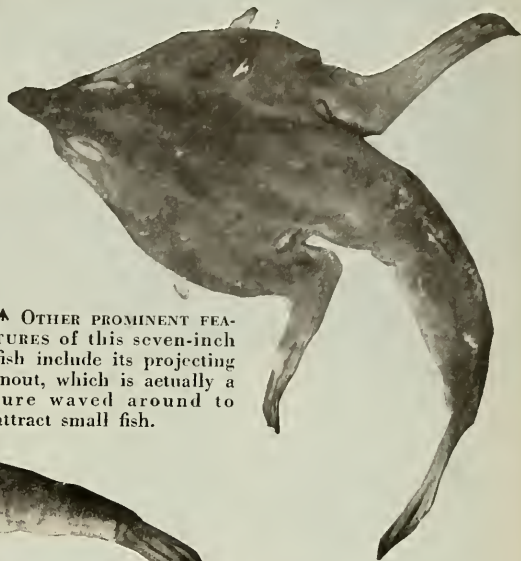
“When it reached the surface again,” he continued, “I grab it. Then I know I have something new! Could be only one ever caught! Ah!, what a big noise it’s going to make when I take it to ‘Scripps’!”

This was the account of the capture, told to me by M. M. Cardozo, a member of the crew of the tuna clipper, *Mary E. Petrick*.

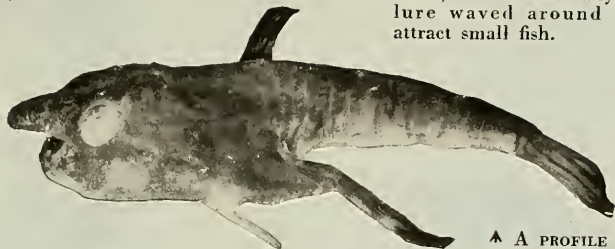
While I studied the specimen from every angle, trying to memorize all the peculiar things about it, visions of a series of photographs ran through my mind, and I longed to learn the name of the creature. Perhaps Mr. Cardozo guessed my thoughts, for he generously offered to let me — a perfect stranger — take it home for a day or two. Carefully I climbed the rail of the clipper and onto the gangplank carrying a quart jar of alcohol containing the oddity.



▲ WITH its arm-like appendages (pectoral fins) and "legs" (pelvic fins), the fish climbed the side of the net!



▲ OTHER PROMINENT FEATURES of this seven-inch fish include its projecting snout, which is actually a lure waved around to attract small fish.



▲ A PROFILE VIEW reveals how large the snoutlike lure is in relation to the rest of its body.

Closer study showed that the large "nose" was no nose at all, for the breathing apparatus was represented by gill slits — one at the base of each "hind leg." Underneath the bony, nose-like structure was a comparatively large cavity. Within the cavity could be seen a strange growth, resembling two miniature egg yolks sticking to a stem of cartilage. What purpose this growth served I could not guess. The skin was like fine sandpaper.

Several of those who came to take photographs were struck by the animal-like appearance of the creature and were curious to know its position in the scale of evolution. I could only promise to pass their enquiries along to those qualified to answer such questions.

I was unable to learn if any other specimen of the "Thing" had ever been found in local waters, and Mary E. Petrick sailed without the find being identified. Pictures of it

were rushed to various institutions of natural history in the United States in the hope of learning its identity and life history. When the pictures reached the hands of an expert ichthyologist, the mystery was soon solved. I was advised that this strange fish belonged to the family *Ogcocephalidae*, genus *Ogcocephalus*, commonly known as "Batfish," but not to be confused with the giant mantas which are sometimes called by that name.

Alluring "Nose"

The "arms and legs" which give the fish such an animal-like appearance are the pectoral and pelvic fins, while the strange growth within the rostrum ("proboscis") is a lure — a greatly modified first dorsal spine — which the fish waves about to entice victims within range of its mouth!

This type of fish, I learned, is definitely not in the line of evolution

of either amphibians or mammals, even though there is a superficial resemblance in the fore-limbs, which do greatly resemble, and function, as arms. This is, instead an example of what biologists call convergent evolution: development of a similar structure from separate and distinct lines.

Although quite rare, this fish is not unknown, several specimens have been found before — all from the waters of the Galápagos Islands. Formerly this family of fishes was represented in Pacific waters by a single species (*Ogcocephalus porrectus*), dredged from the depths of Panama Bay many years ago by the U. S. Fisheries steamer *Albatross*. It was not until April of this year, however, that it was definitely determined that the species is new. It will soon be christened with a scientific name by Dr. Carl L. Hubbs of the Scripps Institution of Oceanography.



Chase the Wild Goose

A man alone on a wild river pits his wits against
one of our wildest birds and ends up with a family

By JACK C. COUFFER



*Ducks
Unlimited*

◀ WITH WING
RAISED, the gander
trumpets his
warning, ready
to fight for his
family.



C. L. Broley, National Audubon Society

▲ EVER ON THE ALERT at nesting time: a pair of Canada Geese near their nesting site.

I SWUNG my photographic equipment into the skiff beside my sleeping bag, a borrowed canvas tarp, and a couple of cardboard cartons of canned food. Then I climbed in, and shoved off into the current of the Snake River. Michael Kershaw, State Game Protector of Kennewick, Washington, nodded good-by.

"I'll pick you up in five days," he said. "You'll see where the road comes down to the river about 20 miles below the junction of the Columbia. That's where I'll be. Good luck." As an afterthought he added, "And if you don't know these honkers, you'll need plenty of it."

Even before he pulled the empty boat-trailer away, I was in the strong grip of the river. I boated the oars and let the current carry me. In a few minutes I was around the first bend, alone on the quiet Snake.

In the rush of the past few days I had barely had time to think about the prospects of this assignment. Four days ago, a friend had called me in Los Angeles from New York. "We're making a picture for Ducks Unlimited on the life history of the Canada Goose. We need close, intimate views of the nesting, and of the adult birds with their young. We have word that the birds are hatching now up on the Snake and Columbia. Can

you get up there right away, before it's too late?"

I told him that I could but that the closest I'd ever been to a wild Canada Goose was on the ground with a V of them so far above that I could scarcely see them. He said that was all right. He was sure I wouldn't have any trouble.

All the long plane ride from California I had had no reason to question his confidence. After all, photographing a Canada Goose's nest should not be different from photographing any other kind of a wild bird's activities, and I had done enough of that. Not until I met the game protector at the airport and saw his skeptical stare did I begin to worry.

When Michael Kershaw looked at my telephoto lenses, he shook his head. "When an old goose hen is on the nest," he said, "she's not like any other bird. Birds, generally, are the victims of their own behavior patterns. You know what to expect from them, and they'll do about as you predict. But a honker's different, particularly when brooding. A honker can think, and they can outfigure you every time. A Canada Goose doesn't like people, and she's not going to let you get close enough with that camera to see anything but empty sky and river."

These recollections flashed through my mind as I drifted down

the river, and then I gave my attention to more immediate things. It is a wonderful experience to be carried silently by the water past a new and exciting wilderness. Where the current sped rapidly, piling up against the shore of a wide curve, a movement in a tangle of willows caught my eye. It was a hunting mink, as completely unaware of my presence as if I had been a log drifting past. The animal splashed through the shallows along the shore and disappeared into a mass of drift logs.

When I passed another bend, I saw the first of the gravel islands that were the nesting sites of the Canada Geese. I took up the oars then and rowed quietly across the current to the lower end of the gravel bar.

The geese choose these islands for the protection they provide. Many of the bars were merely low barren humps, swept by high flood water. Tangled piles of drift logs were scattered here and there. When I landed my skiff on this first island, I was not able to see a single living thing. The surface of the ground was paved with an even layer of rounded stones the size of baseballs. Otherwise, it was so bare that when I stood at one end, I could easily have seen any small movement at the opposite end.

I started walking fast to explore this small spot of land and get on



Lynwood M. Chace, National Audubon Society

▲ TUFTS OF DOWN plucked by the goose from her body for the nest, here betray its location.



Jack C. Couffer

▲ THESE EGGS were not laid together, but incubation began only after all were laid.

Jack C. Couffer



Jack C. Couffer

▲ THE AUTHOR provides warmth and shelter for his adopted, homeless goslings.

◀ MOTHER GOOSE superintends an outing on the water.



to the next one. I had gone only a short distance when I came to the first break in the even contour of the island—the weathered white form of a beached log. From the end of this log, not more than ten feet ahead of me, there was a quick movement and an explosion like a shot. I reeled backward, startled as though I had been grabbed from a dark doorway. With wings pounding the air, a tremendous bird was propelling herself upward in front of me. She rose fast and noisily, like a pheasant out of a stubble field.

When I regained my composure, I realized how astonishingly large she was—possibly 5½ feet from wing tip to wing tip. Her wings were now moving in a slow pumping rhythm, not fast like the egg-beater hammering of her near-relatives, the ducks. In a moment she was joined from somewhere by another bird, and the pair circled away down the river, calling in loud protest at my intrusion. I quickly examined the nest of nine large white eggs and then went to the end of the island.

Walking more carefully now, I was able to make out the next nest before the bird rose. But she had seen me, and had further been alerted by her mate, who was circling in fast turns high overhead, honking loudly to announce my coming to all the world. The hen lay low on the nest, her neck stretched out like a snake along the ground. She quivered with the urge to flee but stayed until the last moment, making use of the sudden explosive rise to startle her enemy.

It was obvious that there was no way to photograph these wild geese satisfactorily on the barren gravel bars. I returned to my boat, trying to puzzle out a way, recalling the game protector's lack of optimism.

Ahead of me on the river lay the second nesting island in the chain of several dozen. It was larger than the first, as big as two city blocks, and on the lower section the gravel rose to form low hillocks. There

was cover on this island—willow clumps, grass, and small trees—which might improve my chances.

I crawled on my hands and knees through a dense growth of willows. When I came to the end of it, I saw a meadow yellow with low-growing flowers. I was near the base of the island's highest hill. On its summit was the alert figure of a honker silhouetted against the sky. The bird was obviously on watch and taking his job very seriously. He had probably seen my boat land a quarter of a mile away.

I started to move on under the willows to search out the female on the nest; then I was aware that the old sentry was staring right at me. Presently he began to honk, his loud trumpet blaring out like an auto horn on a quiet Sunday morning. He then took wing and circled high above, all the time sounding his hysterical warning call. The goose kept to the nest until I was very close, then she rose suddenly with a frenzy of wings.

Success at a Price

I moved to the nest quickly and examined the eggs. Two of them were pipped, and by listening closely I could hear the tiny sounds within. This, I thought, was my chance. With the chick about to hatch out, the old bird would not dare to stay long off the nest. There was good cover near by where I could build a blind. It would be my first opportunity to see an adult bird with newly-hatched goslings.

I set up my camera in a good spot, covered it well with boughs, and then walked conspicuously away so that the adult birds would see my departure. I waited by my boat for half an hour, then started back toward the blind, moving as carefully as I could. In another half hour I inched into the blind on my belly and carefully spread the branches in front of my face. The goose was on the nest. She had not seen me, but she seemed to sense my presence. Her neck was raised high and she turned her head nervously, this way and that, constantly shifting her bright-eyed stare.

Close on my right, nearer even than the goose's nest, stood a beaver on the bank, hunched over a willow branch which he was stripping of bark. He worked hard, without a sign of apprehension. His attitude told me I had made a good entrance into my blind.

Presently the goose turned her attention to the nest below her breast. Her graceful neck arched forward and down. I could see that she was nuzzling a newly-hatched gosling with her bill.

My camera began to roll. The low whir of its motor sounded loud in the stillness. For a moment I thought the goose would hear it, but I was down-wind, and the bird's attention was held by the sounds of the goslings beneath her. They were hatching fast now. The eight eggs would have been deposited in the nest over a period of two weeks—one every other day. But since the mother goose does not start to incubate them until all are laid, they hatch at about the same time.

I felt that I was filming some good material, and I looked forward to getting more. The light would soon be fading as evening approached, and already thin clouds to the west were taking on a rosy color. I took another look through the viewfinder. It was then that a blast sounded close behind me—so loud that I nearly jumped out of the blind.

The old gander was standing just a few feet from me, staring in terrified surprise. He vaulted into the air, honking loudly, and was followed immediately by the startled female.

At this critical time for the young birds I did not want to keep the adults off the nest. So I took my camera and hurried back to my beached boat and camp, hoping that the adults would soon return. An hour later, just when the last twilight was about to go, I crept back to a distant position where I could observe the nest with binoculars. The adult geese had not come back.

I slept restlessly, worrying about

the goslings, hoping that the old birds had returned. In the morning I went immediately to the nest. The adults were nowhere to be seen. All but one of the goslings had hatched. The unhatched egg, chilled, was pipped heavily. I helped the bird out, lifted the entire nest, goslings and all, and placed it in one of the cartons that had held my canned food. I was learning my lessons about photographing Canada Geese the hard way, but I would not again make the mistake of driving adult birds away from their nest. I hoped that the disturbed pair would lay again this year and try another clutch against the terrible odds that nature and man has provided against them.

Now, for the rest of my trip down-river, I had a family to care for. I reasoned that, like new-hatched chicks, the goslings would not need nourishment for the first day. I took them to a shallow pool at the edge of an eddy and let them wade around. They drank and snapped their bills, chewing at the water. They would not venture far from me. They behaved just as if

I were their true parent, and I accepted the responsibility, little knowing what I was letting myself in for.

After they had taken their morning's wade, I put the goslings back into the carton, packed my meager camp, and we started down the river toward the next island.

It was one of the barren gravel bars. I could almost predict now where the nests would lie. One would be found at the base of each of the three drift logs that lay where the high water had left them. But I was a little off. Only two logs had nests; a third had been placed without apparent reason in the middle of the flat plain near the center of the island.

One of the nests contained four eggs. Incubation had not yet begun, and the nest had been carefully concealed by the female, who had covered it with part of the down that she had pulled from her breast to line it. In another of the nests there was a round stone the size of a golfball set between the eggs. I saw this curious thing many other times as I continued down the river—one or even two or three

pebbles in with the real goose eggs.

At the far end of the gravel bar, I saw a fleeting movement. Hurrying to a high point, I swept my binoculars across the stones. An adult gander was standing in the shallow water at the river's edge. Fifty yards inland another adult bird was running rapidly toward him. She held her neck straight out ahead of her, parallel to the ground and very low, making an inconspicuous silhouette. She ran with remarkable speed, and (even more remarkable) her brood of olive-colored goslings were strung out right behind her. The small birds were tumbling along over the stones, falling and getting up again, their legs moving rapidly to keep up. The goose went into the river beside the gander, and they waited a moment for the brood to catch up. Then they swam rapidly away across the river, the young birds close between them. I realized then why I had not seen more adult birds with new young. It was as Kershaw had said, the geese had been outwitting me, eluding me before I had reason to suspect their presence near by.

▼ POISED READY FOR FLIGHT, this Canada goose seems to sense the presence of the photographer near by.

Donald M. Cooper, National Audubon Society



My third evening on the river a bank of leaden clouds appeared in the west. They were moving rapidly, as if hurrying to catch up with the high cirrus that speckled the sky ahead of them. Before dark I pulled my skiff up high, propped it up, and threw the tarp over it to make a shelter. In two hours, just at dark, a cold wind began to blow, flapping the canvas against the metal boat. I gathered as much wood as I could find and started a fire to keep warm.

All-Night Baby Sitter

My goslings were all doing well. Even the late-hatched one was now indistinguishable from the others. That morning I had allowed them to forage for an hour at a small pond of trapped water at the river bank. There they had chased insects and presumably found something to eat. During the day, they ate from a dish of oatmeal that I put out in the carton for them. I had by now grown quite attached to them and was determined to get them safely down the river and into Kershaw's hands. He was a game protector, and here was some

game that surely needed protection.

About eight o'clock it started to rain, softly at first, drumming in distinct drops on the canvas overhead. Then it came down hard, in a steady roar. Cold came with the rain, and my fire was soon out. I thought of the goslings in their carton. They were huddled together in a ball, trying to keep warm, and were not, I was afraid, having much luck at it.

I started another fire, just inside the entrance to my shelter, and tried to dodge the smoke that was swept into the hut. I noticed that my shelter was serving much like a chimney. The smoke was billowing through and out the other side as if the shelter had been designed for that effect. To keep the smoke out of my eyes, I had to sit almost in the rain. The goslings' carton stood at the edge of the warm fire glow, and I observed with some consolation that the birds appreciated the heat. About midnight the rain changed to light snow.

I was convinced that if the fire should go out, the goslings would be badly chilled. Because of this, I sat up all night in my sleeping

bag, dozing uncomfortably, drying rain-soaked wood, and adding it to the fire as needed.

Shortly after daylight, the rain and snow stopped and I went on down the river. That night it was cold and it rained again. I was so tired by now that I feared I would fall sound asleep and let the fire burn out. I had kept my goslings alive this long and was determined that they should not freeze now. Somehow I kept awake.

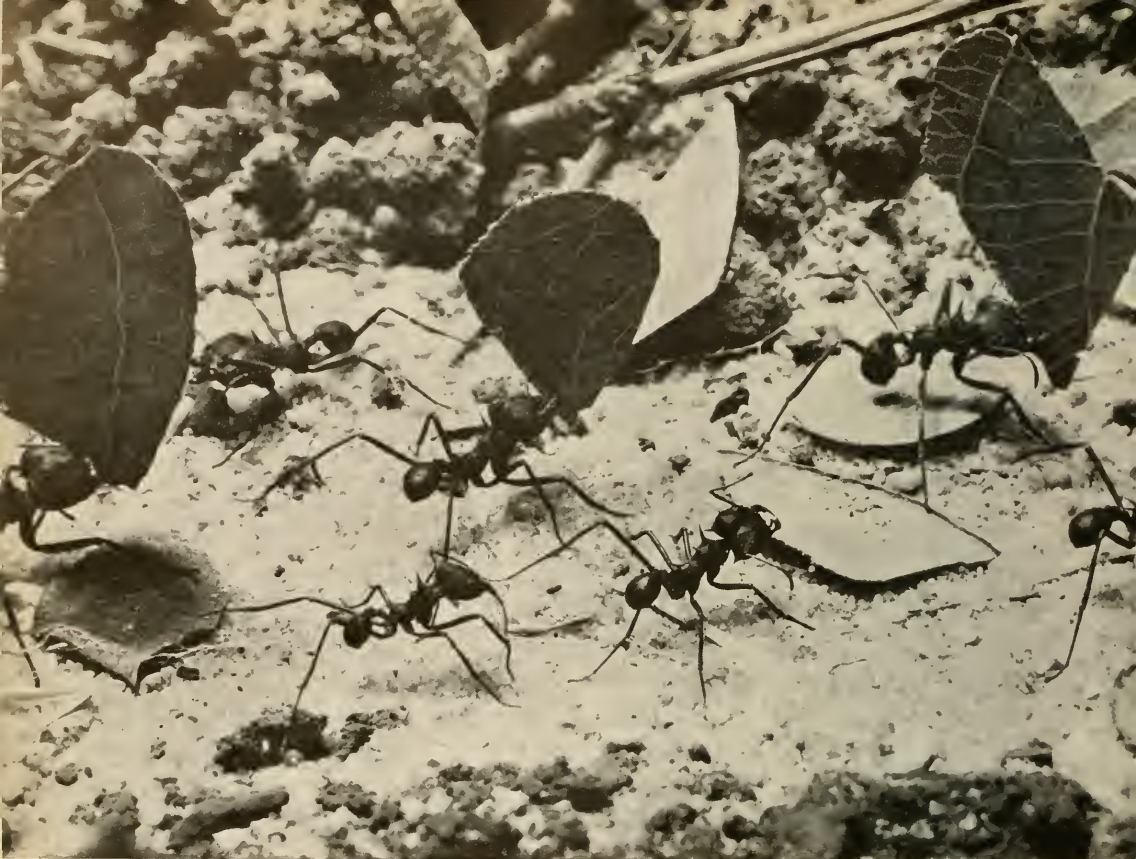
Kershaw met me as he had said he would. It was good to be sitting in the cab of his pickup with the boat in the trailer behind. The birds were in the carton on the seat between us.

After balling me out for molesting the State's game, the protector told me that he was sure Wadkins, at the state game farm near Spokane, would be delighted to rear the goslings. The sun shining in the window at the side of my head made me sleepy. I stopped trying to keep awake. In my mind, the familiar expression was repeating itself over and over: so this is what they mean by a wild goose chase.

▼ A GANDER stands watch while the goose, followed by her goslings, enjoys a swim.

Joe Van Warner, National Audubon Society





Ants that Grow **MUSHROOMS**

Deep beneath the earth, the leaf-cutting ants convert their "parasols" into fertilizer for fungus gardens that provide them with food

By ROSS E. HUTCHINS

Photographs by the Author

STRAY breezes rustled the foot-long needles of the pines, and the sawing of katydids resounded through the soft Louisiana night. I sat beside a miniature path that meandered away through the growth of scrub trees and dense weeds. It was only three inches wide, and it disappeared to the left beyond the range of my flashlight. To my right,

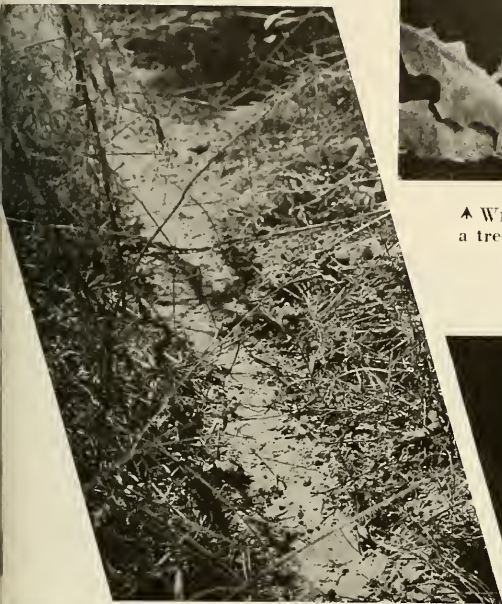
however, it entered a small tunnel formed under the brown needles that had fallen from the graceful longleaf pine above. This path had been worn down nearly a half inch into the sandy soil by the hurrying feet of countless thousands of leaf-cutting ants on their nightly foraging expeditions.

Tonight they were cutting leaves

from a chinquapin several hundred feet away, and their columns were passing me and disappearing into the arched tunnel. To a casual observer it might have appeared that a stream of leaf fragments were mysteriously bobbing and jostling along on edge down this narrow trail. Actually, beneath each bit of green leaf was an ant, which was holding the

❖ A NUMBER OF KINDS of fungus-growing ants live in the United States, but most spectacular are these Texas leaf-cutters, *Atta texana*.

▼ ANT HIGHWAY. Thousands of hurrying ants carrying leaves to the underground gardens produced this typical path.



▲ WHAT IS LEFT after a visit of the leaf-cutters. They can almost strip a tree overnight. They also collect various berries and stock feed.

▼ A PARASOL ANT of the worker caste, carrying its burden to the fungus gardens.





▲ MOUNDS LIKE THESE mark the location of elaborate underground fungus farms. Some run 20 feet beneath the surface. If a colony like this moves or is destroyed, a large sinkhole may appear.

fragment vertically in its jaws as it hurried along. There appeared to be a definite urgency about the actions of the ants, as if each one were a tiny automaton driven by the will of some troglodite taskmaster deep within the earth.

Several yards down this ant trail, a small root lying across the path just above the surface obstructed the even flow of ant traffic. The toiling ants invariably bumped into it with their loads and only negotiated the barrier after several frustrating tries. Eventually, however, each one got across by bungling around or over it and again hurried along.

Their burdens were by no means light in the ant scale. Frank E. Lutz once found that some leaf-cutters in the Panama Canal Zone (*Atta cephalotes*) carried leaf fragments weighing eight times as much as themselves. If the ants could be enlarged to the size of people, this would be equivalent to carrying 1000 pounds at a fast jog.

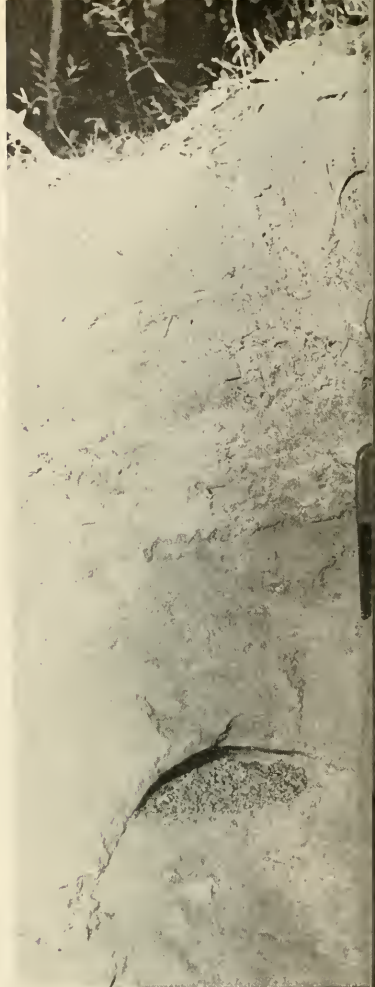
From where I watched I could spot individuals carrying leaf-fragment, of exceptional size or of unusual shape and could follow them with my flashlight. I tried to estimate the time they would take to reach the smooth stretch in front of me where I had my camera and electronic flash set up. But time after time before arriving within camera range, an ant with an especially handsome leaf would become hope-

lessly involved with a stray pine needle or some other obstruction and drop its burden. As far as photography was concerned, it was a discouraging business.

Two-way Traffic

Close observation revealed that there were really two columns of ants; those going toward the chinquapin "empty handed" and those returning laden with leaves. Also there were ants of various sizes traveling this busy thoroughfare. First, there were the large leaf-carrying ants. Then there were smaller types that scurried along with their sisters and in some cases rode homeward on the leaf-bits carried by them. Here and there, large soldier ants with formidable jaws could be seen. These toiled not.

As my flashlight illuminated the advancing column, I was amazed to see flashes of light like tiny headlights coming down the path, and I had the distinct impression that the mouthparts of the ants were fluorescent. Closer observation, however, revealed that what I saw were reflections from the flat, highly polished front sides of the ant's mandibles. This was a simple explanation, yet it added another eerie touch to the night and the somber forest. I knew that even stranger things were taking place deep within the dark nest chambers in the earth which this struggling column of leaf-cutting ants had as its destination.



▲ A TYPICAL VIEW inside a large colony. Other nest cavities were

Many others have observed the leaf-gathering activities of the *Atta* ants. It was, in fact, the sight of a leaf-bearing file of these ants hurrying along the bank of Barton Creek near Austin, Texas, that first kindled the interest of William Morton Wheeler in the study of ants. His interest became his life pursuit, and he earned distinction as the world's foremost authority on these amazing insects.

No ant, of course, with the spectacular habits of the leaf-cutters could long have escaped human observation. There is ample evidence,



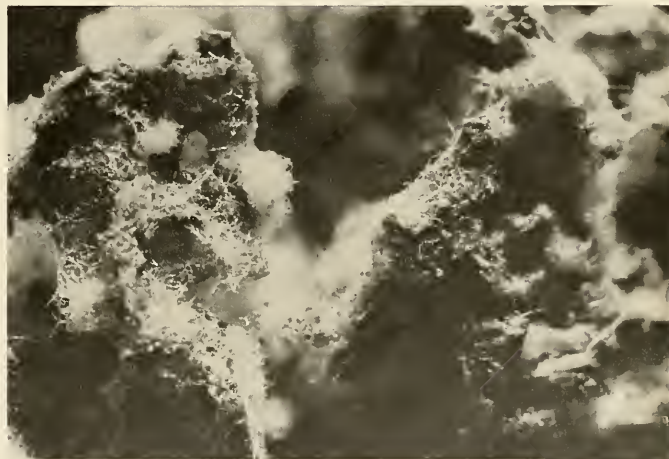
ound below and in all directions. The
unnel extending upward led to surface.

from legends, that even the natives of Central and South America had watched them on their leaf-carrying safaris. H. W. Bates in his classic, *The Naturalist on the River Amazon*, describes the activities of the South American leaf-cutters, or "Saubas." His observations were made in 1863. Prof. S. B. Buckley was probably the first naturalist to study the Texas and Louisiana leaf-cutters, *Atta texana*. Both of these men, along with many others, found the habits of the ants interesting, but they missed the most astounding fact about them. They did not realize

ANTS THAT GROW MUSHROOMS



▲ THE FUNGUS GARDEN from a single cavity: a spongy mass. Different ants cultivate different fungi. They prevent the fungus from producing actual mushrooms.



▲ AT VERY CLOSE RANGE, the thready mycelium can be seen growing over the surface of the leaf fragments. The white clumps are the *bromatia* upon which the ants feed. They result only under cultivation by the ants.

how the leaf-cutters used the leaves and other plant debris that they carried into their subterranean chambers in such quantities.

Thieves in the Night

Your attitude toward the leaf-cutters depends upon whether you are a biologist or a farmer, for they harvest leaves in such quantities that they are a serious agricultural pest in many places in the American tropics. Even in Texas and Louisiana they do great damage to trees and gardens. They are especially injurious to seedling pine plantings,

because they cut and carry off the tender, grasslike, sprouting pines. Strangely, they do not confine their depredations to green forage but will often invade granaries and carry off ground chicken feed. It is said that a large sack of feed may be emptied in a single night.

The farmers of Louisiana annually use hundreds of gallons of carbon disulphide to destroy the colonies by fumigation. These sprawling colonies in Texas and Louisiana, which are locally referred to as "ant towns," often cover a hundred square yards.



▲ A WORKER looks small beside the queen. She has severed her front wings in this picture. Even smaller than the workers are the minors, which "weed" out foreign fungi from the garden.

A farmer who sees his orchard or garden going down a hole in the earth is not especially concerned about the ultimate use that the thieves make of the booty. But biologists began at an early date to ponder the question, and the theories were almost as numerous as the biologists who propounded them. One favorite idea was that the leaves were employed to line the subterranean cavities in which the ants lived. As late as 1870, B. R. Townsend, after studying these interesting ants in Texas, concluded that "... the leaves by their decay produce a gentle heat, or, at least, maintain a uniform temperature whereby the eggs are hatched. Formerly it was suggested that these leaves constituted a store of food, but such is not the case." This perhaps, should be a warning to biologists against making dogmatic statements, since it was only four years later that Thomas Belt settled the matter once and for all when he wrote: "Some Naturalists have supposed that they use [the leaves] directly as food; others, that they

roof their underground nests with them. I believe the real use they make of them is as a manure, on which grows a minute species of fungus, on which they feed;—that they are, in reality, mushroom growers and eaters."

Intimate Relationship

This was the solution to the puzzle, and it has never been seriously questioned. Years of careful study by many eminent formicologists have shown that these ants live in intimate symbiosis with the fungus that they so carefully cultivate. In fact, it is now known that there are nearly a hundred different species of fungus-growing ants, all in the New World, and mostly in tropical areas. In the United States there are a number of species; *Trachymyrmex*, for example, is rather common over most of the East. Of all our native species, however, none has the spectacular leaf-carrying habit or occurs in such tremendous colonies as the Texas leaf-cutter.

To study this ant is a man-sized job requiring muscles and a total

disregard for personal discomfort. These ants do not sting, but the larger castes are equipped with powerful mandibles, which can easily draw blood. Thus, to excavate one of the colonies is a project of major proportions. The large nest cavities begin at a depth of about four feet. As one digs, he soon finds that the entire area is honeycombed with tunnels and hundreds of cavities. These range in size from small coconuts to chambers several feet long, a foot wide, and eight inches high. Dr. M. R. Smith of the U. S. National Museum once excavated a nest in Louisiana that had a gallery leading almost 20 feet below the surface! The amount of earth that is excavated by these busy insects is truly amazing. The writer found a place where a farmer had killed out a colony the year before, and an area 30 feet square had sunken nearly a yard below the level of the surrounding ground.

Each of the numerous nest cavities is filled with the grayish mass of the fungus garden, in various degrees of development. This mass

is more or less honeycombed and over and through it can be seen thousands of busy ants caring for it. Close observation quickly reveals that they are of several sizes. The smallest are called the minims, and they are very tiny. Their work is mostly weeding out foreign fungi. The leaf-cutting crews are bound to carry in endless kinds of fungus spores that do not serve any good purpose. Yet the work of these minims is so efficient that no foreign fungus is ever found in the garden.

This brings us to the fact that the fungus cultivated by these ants is a very special kind found nowhere else. As a matter of fact, each kind of fungus-growing ant usually cultivates its own special kind of fungus. However, Dr. Neal A. Weber of Swarthmore College has had considerable success in inducing some fungus growers to live on the fungus of other species. It is interesting to speculate on the fact that this remarkable form of agriculture was developed perhaps millions of years ago, long before man even existed.

Most of the fungi grown by ants belong to the same plant group as

real mushrooms and toadstools, but the ant fungus never develops into mushrooms as long as the ant colony is in control of it. There have been a few cases in which typical mushrooms of tremendous size have appeared over abandoned nest sites, which seems to indicate that the cultural control practiced by the ants keeps the fungus in the mycelial form.

Fungus Food

One of the rather intriguing things about this fungus is that while under cultivation by the ants it produces numerous clumps of clublike bodies called *bromatia*. It is these that constitute the ants' food, not the thread-like mycelia. They do not appear without the ants.

When the collected leaves are brought into the underground chambers, the work of converting them into compost devolves mostly upon the larger workers. However, even the tiny minims help out with the labor of dividing the leaves into small pieces and planting them with fungus. This new plant compost be-

comes covered with a white mass of fungus mycelium in about 40 hours — if conditions are right, and that "if" is most important. Very precise conditions of temperature and humidity must prevail if the fungus garden is to flourish. The marvelous thing is that the ants are able to maintain these exacting conditions without the aid of delicate instruments such as we would find necessary. It is done in a number of ways. For example, leaves are cut only at night or on cloudy days during hot, dry weather; and wet leaves are never carried into the fungus cellars. During periods of low humidity, the ants close the nest entrances; and when the fungus gardens become too moist they open additional ventilating tunnels. The writer tried on several occasions to keep fungus gardens of *Atta texana* alive and growing in a glass container, but they always died out in a few weeks, in spite of the fact that both temperature and humidity were carefully regulated by electrical controls. It was obvious that some important environmental factor was wrong.

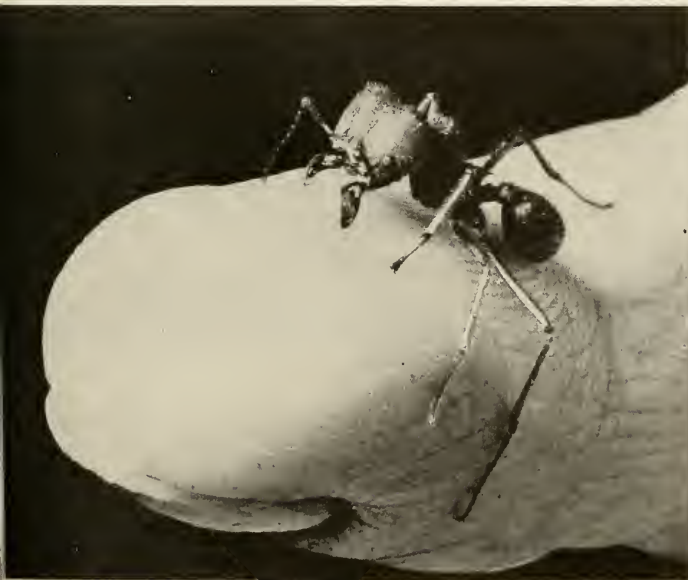
Perhaps the most interesting thing about the leaf-cutters is in connection with the founding of new colonies. It is very easy to tell when the virgin female and the male "town ants" are swarming in southwestern Louisiana. The sex forms are attracted to light at night in astonishing numbers, and service stations and similar establishments are often covered with large winged males and females that have emerged from near-by colonies.

After her mating flight, the large queen ant descends to the earth, severs her wings, and digs a burrow in the ground. She then enlarges the bottom into a small chamber, and finally seals the outside entrance. She is now a prisoner in a self-made prison, and you might well ask how she is going to start a mushroom garden and begin rearing young. This is a question that bothered the early student of the *Atta* ants. The answer, when they finally found it, brought to light one of the most fascinating adaptations in nature.

Before the queen departed from

continued on page 499

▼ THE SOLDIER ANTS do not work in the gardens, and when picked up they bite viciously. The jaws of this one are imbedded in the skin and drew blood.





▲ HACHIJOH ISLAND, JAPAN, is where this interesting species (*Mycena lux-coeli*) is found. Its bluish luminescence enabled the photographer to get this artistic shot in the darkroom, in dramatic contrast to that taken in daylight below.



Glow Plants

By Y. HANEDA

Luminous fungi found round the world give out a ghostly green, blue, or orange light in the dark

DURING Halloween, an American child wearing a hideous face mask may suddenly loom up in the dark to frighten or startle the unwary wayfarer. In tropical Asia, a similar thing may happen, but the young prankster will have

frightened his elders by smearing a luminous type of fungus over his face to present a weirdly-glowing appearance in the dark.

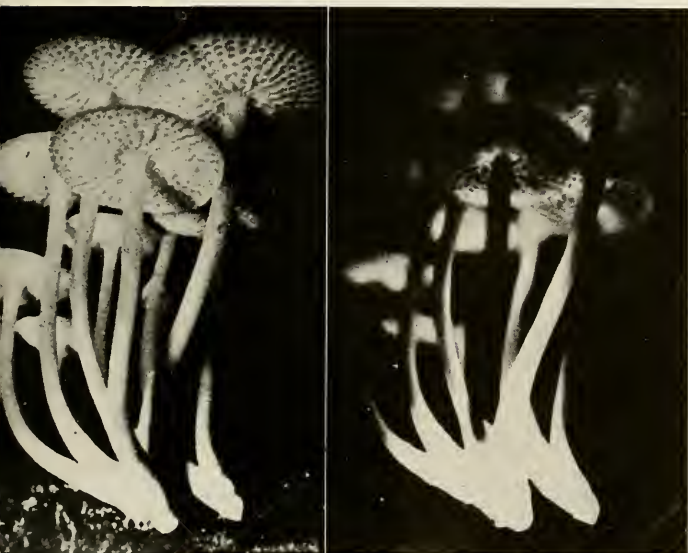
Luminous fungi are found throughout the world; over 50 species have been reported. The great-

er number are exceedingly small in size, but several larger species also exist. Of the large ones, the most interesting is commonly known in the United States as the "Jack-O'-Lantern" or "False Chantrelle" (*Cliocybe illudens*). It has a diameter



▲ SO STRONG is the luminescence of the species *Mycena chlorophos*, that almost as good a picture can be taken in the dark (left) as in daylight (right).

▼ THE WHOLE FRUIT BODY of this species (*Mycena manipularis*) emits a yellowish-greenish-bluish glow. Found in the jungle near Tawao, North Borneo, it has been photographed by daylight (left) and in the darkroom (right) where an F.3.5 lens opening was used with a 60-minute time exposure.



of 5 inches or more, is found around old hardwood stumps, and shines with an orange-colored light.

A well-known, large European species (also found in California) is a luminous mushroom (*Pleurotus olcarius*) which, in Europe, usually

grows at the base of olive trees. In this species, the gills are always luminous, and the entire mushroom usually is, except for the spores. It also gives out an orange to yellow glow. Both this and the "Jack-O'-Lantern" are poisonous.

A large Japanese species, also poisonous, is the "Moonlight Mushroom" (*Lampteromyces japonicus*) found growing only on the dead trunks of beech trees, usually in the autumn. The luminescence of this species is not only found on the gills but also on the spores which fall from them (unlike its European relative).

The greater number of the phosphorescent fungi, particularly the smaller species, are found growing profusely in decayed wood in the forests and jungles of tropical Asia, especially during the rainy season. The most interesting of the Asian species are perhaps the *Mycena pruinosa-viscida*, var. *rabaulensis* of Rabaul, New Britain, and the *Mycena rorida* var. *lamprospora* found in Singapore. These two species are remarkable among luminous fungi in that their spores alone are luminous, and only when damp. Spores that remain dry after falling show no luminescence whatever.

Most of the small Asian fungi are found growing in decayed wood. They will continue growing in a laboratory, provided the proper temperature is maintained. Under laboratory conditions, their behavior, color, and light intensity can be carefully studied.

The luminous characteristics of these fungi vary greatly. The light intensity of some is very strong, while that of others is so weak as to be barely discernible. Some emit light from the entire fruit body, while the light of others is restricted to the gills or the stem, or to the spores or mycelium.

Each fungus has its own particular color. Besides the orange light of the "Jack-O'-Lantern" already mentioned, other examples include the greenish light of the *Mycena illuminans*, the yellowish-blue radiance of the *Mycena manipularis*, and the blue glow emitted by the *Mycena lux-coeli*.

Phosphorescent fungi have long fascinated primitive people in places such as Micronesia where, on Yap Island, an interesting use of these fungi is their appearance



▲ THE LOWER PART of the stem of this luminous fungus, a variety of *Mycena manipularis*, is especially phosphorescent, so that in the picture taken in the darkroom the stems resemble electric tubes! At right is a prosaic view taken in daylight. It glows with a bluish luminescence. (Shown in actual size.)

as hair ornaments for moonlight dances. Long ago on Palao, native women wore phosphorescent fungi in their hair as bodkins. The average native, however, does not show any enthusiasm for the little fungi, but more often than not regards them as a bad omen. The mycelium of luminous fungi (the vegetative phase, composed of a mass of fine threads) thrives on dead leaves and decayed bark and limbs of trees.

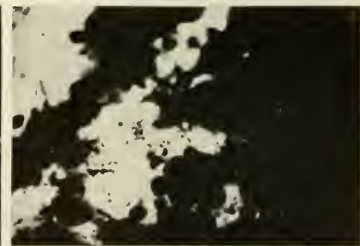
The resulting blue arms of light outstretched in a forest have given rise to many local "ghost" superstitions.

But a practical use for these luminous fungi is possible. The light emitted by some of them is sufficient for taking pictures in the photographic dark room, provided a supersensitive film is used. With Eastman XX, an F.1.5 lens opening with a 30-minute time exposure, or

an F.3.5 opening with an exposure of between 1 and 2 hours, using only the fungi for light, gives good results. Color film requires an exposure of 3 to 4 times greater length.

Look carefully during your next walk through the woods, it is possible that you too may spy a specimen of these interesting fungi, and you can conduct your own experiments.

▼ It takes a photograph under artificial illumination to show this species, *Mycena pruinoso-viscida*, for only its spores are luminous, and only when damp, as shown at right.





The first expedition to set foot on Alaska was organized by Russia, led by a Dane, and described by a German, Georg Wilhelm Steller.

By ANN and MYRON SUTTON

WHEN the great Swedish botanist Linnaeus chose the name *Stelleria* for a new plant genus, he asked: "Who has earned a greater or more precious glory for his name than he who undertakes journeys among the barbarians? Everybody in the botanical world who knows plants loves Mr. Steller. If my appeal

has any influence with you, I beg you to adopt the name."

Were Linnaeus alive today he would find, happily, that Steller's name now applies to an Alaskan heather, a blue jay, a duck, a molly, three fishes, a sea cow, a sea lion, a sea cliff and two mountains!

This is the avalanche of honors

that history has heaped upon Georg Wilhelm Steller, the plucky Bavarian who sledged through Russian snows, crossed Siberian prairies, and sailed through raging Pacific seas to become the first naturalist of Alaska and probably the first white man to set foot on Alaskan soil.

In his pitching cabin aboard *Vitus*



Courtesy American Geographical Society

▲ THE TWO SHIPS put out from Avatcha Bay, Kamchatka, on June 4, 1741.



▲ MT. STELLER, a 10,000-foot peak comm

Bering's flagship, Steller wrote some of the world's finest descriptions of North Pacific sea animals. He gave astonishingly complete and detailed accounts of the fur seal, sea cow, sea lion, and sea otter at a time when the world scarcely knew such animals existed. Most of these works were published in his immortal *De bestiis marinis*, an ambitious scientific project if there ever was one. But writing alone did not make Steller famous. Curiosity and adventure did.

Steller's abiding passion for natural history kindled his destiny early. He was born in the Bavarian town of Windsheim in 1709, fourth among eleven children in the family of Cantor and Frau Jacob Stöller. It was a good life. Cantors—whose eighteenth-century contemporaries included such noteworthy figures as Bach and Handel—had no trouble becoming respected members of the community, and young Georg Wilhelm grew in prosperous musical tradition.

Persistent though he may have been as a scholar, poet, and musician, the irresistible appeal of Windsheim's Schossbach Forest lured him deeper and deeper into the magic of the outdoors. Fox and deer bounded among the trees. Blackcock and capercaillie mated noisily in spring. Hazel grouse whistled deep in the woods. Soon partridges and

river otters began to impress Steller more than rondos and minuets. The inspiration of Windsheim's forests filled him with a desire to learn more about the natural sciences.

In 1730, Steller transferred from the University of Wittenberg where he had been a theology student to the University of Halle to study and teach natural history. But even as he explored the forests and gardens of Halle, even as he toured the tunnels and galleries of Stolberg or hiked the beautiful valley of Tyra, his imagination flamed with an unquenchable curiosity about the great wide world beyond.

He vowed to see it. He read the voyages of Dampier and other seafarers, pored over *Robinson Crusoe*, and dreamed of sailing to remote and uninhabited islands where untapped natural history lay waiting for discovery.

After his botany lectures mushroomed into wide popularity at Halle, Steller went to Berlin for an official certificate of professorship. He had no difficulty with the examination, but the king—who dispensed such appointments personally—fell ill at the wrong time, and Steller failed his professorship by royal default.

Unsubdued, Steller turned his clear, piercing eyes toward new horizons. Now more than ever the lure

of the unknown gripped him. He needed a job. University life seemed dull and listless. The pages of *Robinson Crusoe* swam again before his vision.

Bering Expedition Organized

At this psychological moment news arrived from Russia that Fleet Commander Vitus Bering had begun outfitting prodigiously in St. Petersburg for an expedition to the vast, unknown Kamchatka region north of Japan. Steller needed no second cue. He hired on as a doctor with the Russian Army in Danzig and sailed to St. Petersburg in hopes of attaching himself to Bering's expedition.

But the fact remained that Steller knew neither Russian nor Russia itself. A bewildering hodgepodge of strange customs, languages, and nationalities confronted this young, impetuous German. Though Peter the Great had taken Russia out of medieval mothballs, there still remained a wild barbarism: the public torture of witches, and robbers hung in muddy streets. Even that august body of patron learning, the Academy of Sciences, adjourned so its members could witness humanity's sidewalk spectacles.

Nevertheless, as Bering's expedition departed for Siberia, Steller settled patiently at the newly organ-



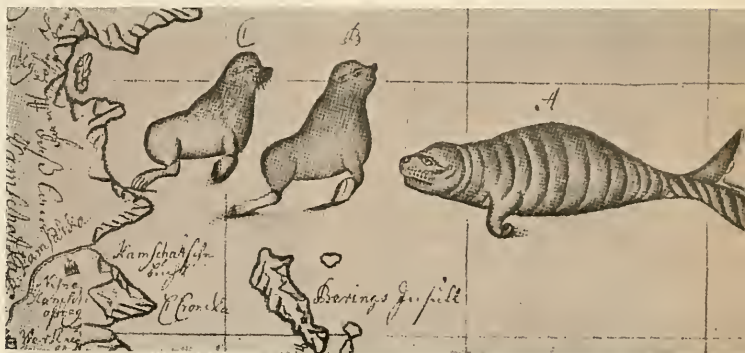
D. J. Miller, U.S. Geol. Sur.

ing the naturalist's landing in Alaska.

ized Academy of Sciences to study languages, geography, and science. He didn't wait long. News soon came from the east that Bering had decided to add two new scientists to his command. Within a year Steller's dream came true. He had been selected as one of them. Thus it was that a Russian expedition under a Danish leader came to have a German as its outstanding narrator.

Nothing before or since has benefited Russia quite so much as the wave of scientific and cultural enlightenment that swept her during Peter the Great's reign. Frontiers of knowledge expanded in all directions, and the physical frontiers of Russia's vast borders were being explored and mapped. Although Bering's first voyage had been a part of that nationwide reawakening, it had stirred up such wondrous tales that the authorities could not quite credit all the results. Thus his second voyage, which Steller joined, was intended not only to expand but to corroborate the first.

The Admiralty's instructions were to survey and map northern Asia and parts of America, to chart the Arctic coast, to establish astronomical positions throughout Siberia, and to find out, once and for all, if Russia touched America. To do so, Bering organized several expeditions and hauled his supplies and



Courtesy American Geographical Society

▲ FUR SEAL, SEA LION, AND SEA COW on Lieutenant Waxel's chart. This and one other drawing by him are the only existing portrayals of the sea cow. Drawings made by Steller's assistant, Plenisher, have been lost.

equipment 4,000 miles across Asia.

Steller was jubilant. He finished his projects at the Academy of Sciences and eagerly made preparations for traveling cross-country to join the expeditions then in or en route to the Pacific.

With the lighthearted temperament that flooded him, Steller fell in love with the widow of the nation's leading authority on Siberia. Presently they were married. But he was so happily in love and so intent on taking his bride along (he would be many years in the wilderness and at sea) that he was unprepared for the shock that followed. When they had traveled as far as Moscow, she refused to accompany him farther. She may have been right: still ring-

ing in her ears were bitter descriptions of Siberian winters detailed by her first husband. No amount of persuasion could change her mind; she preferred the gaiety and comforts of St. Petersburg—and she went back.

After that, Steller continued alone—and lonely—across the brooding steppes, by boat up Siberian rivers, by troika over snow-covered plains, grieving for his shattered happiness. But before he reached the other end of the white continent, the gripping fascination of Siberia's wilderness had captured his innermost being and wrung from his heart the last bitter remorse for his wife. Soulfully he wrote: "I have entirely forgotten her and fallen in love with Nature."

He had indeed. East of the Urals, Steller found barbarism and ruthlessness but paid scant attention to it. So that he could collect and observe more intently, he reduced his personal gear to a minimum. He cooked and ate in a single dish. He wore what clothes he could find or make. When he came down with fever, he pushed on through sub-zero temperatures. In fact, contemporaries described him as impulsive, full of life, tough and indefatigable, unassuming, good-natured, and above all passionately devoted to science.

Three-Year Trek

No branch of natural history escaped him. He encompassed everything from the coloration of redstarts to crustaceans in the Angara River. To secure badly needed paper for pressing plant specimens, he once sledged 333 miles in the middle of winter to a trading center on the Mongolian border.

For three years Steller trekked across the immensity of Russia—through Tobolsk, Tomsk, Irkutsk, Yakutsk, and finally to the Pacific seaport of Okhotsk.

There Vitus Bering's ships—two identical packet boats named *St. Paul* and *St. Peter*—lay at anchor, being outfitted for the trip to America. For this Steller had waited, worked, and planned; for this he had studied at Halle and St. Petersburg. Here lay the goal of his dreams.

With Steller sharing the Commander's cabin on the *St. Peter* and listed officially as ship's surgeon and mineralogist, the expedition departed from Avatcha Bay—on Kamchatka's eastern shore—on June 4, 1741. Of the 78 aboard, almost half were never to return.

Carrying "all sails except the spritsail," they headed east-southeast into the unknown Pacific. Five hundred miles eastward lay Attu and the Aleutian chain, which no white man had ever seen. No one knew where America lay. No chart gave a direction, no log a distance.

On June 20, storm and wind forced the companion ship *St. Paul* to heave to under the mizzensail,

and the expedition's two ships lost sight of each other. The *St. Paul* arrived back at Kamchatka the following autumn. For six weeks the *St. Peter* sailed across the Pacific, occasionally sighting driftwood and seaweed which suggested the nearness of land. Had Bering turned north, he might have found land within 100 nautical miles. But fate guided his course parallel to the Aleutians until at last, on July 16, the clouds unrolled above a majestic panorama of snow-covered mountains and towering peaks. They had reached the Alaska mainland.

Imagine Steller's elation at this epic moment! An entire country lay unexplored at his feet. He noted "with the greatest of pleasure the beautiful forests close down to the sea, as well as the great level ground in from shore at the foot of the mountains." The exultant crew named the highest peak after the Saint of the day: Mount St. Elias.

On Bering, however, the burden of 60 years of toil and hardship lay heavily. He had labored incessantly preparing for this expedition—building ironworks, ships, towns, and forts in the face of innumerable delays, vexations, and setbacks. Little wonder that, having discovered the "big country," he turned his attention not to wild exploration but to the safe and immediate return of ship and crew.

Not so, Steller. To him this was the culmination of years of planning and preparation. When Bering tacked the *St. Peter* in close to Kayak Island and ordered a boat ashore for fresh water, Steller, beside himself with anticipation, refused to be left behind and peremptorily lowered himself into the boat.

Steller's biographer, Leonhard Stejneger, presumes that Steller's eagerness—borne on a decade of dreams and plans—prompted him to leap out of the boat as soon as it nudged the gravelly beach. Thus, though no one knows for sure, it is possible that Alaska's first naturalist was also the first European to set foot on its soil.

At any rate, honors had not beckoned him. Nature had. Leaving the



From a painting by Joseph Wolf, courtesy Harvard Univ. Press

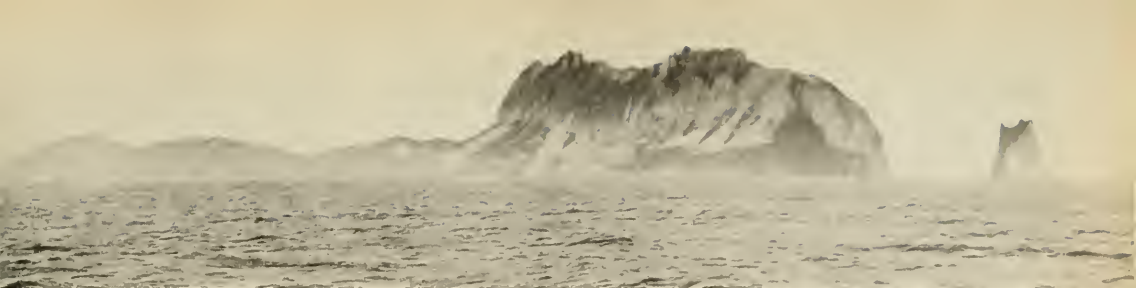
▲ A BIRD that Steller was the only naturalist to see alive: the Spectacled Cormorant. Its wings were too small to carry its body, and by 1850 it had been shot out of existence. Six specimens and two imperfect skeletons are all that remain.

crew to fill the water casks, Steller set out to explore Kayak Island as comprehensively as possible in the scant time available. Abruptly he came upon an Indian cache and fire-place from which the natives had just departed, and he sat down at once to itemize every facet of the scene.

Alone and unarmed, he continued through the thick forest, observing, digging, collecting, always hoping to find his first "Alaskans." From a hilltop he spied the smoke of a distant campfire and rejoiced at the prospect of meeting the natives, learning their customs and language, and securing complete data for a scientific description.

Hurrying back to the beach, he dispatched his plant collections on the boat and asked Bering to send gifts for the Indians. That was at 4 P. M.

Waiting for Bering's reply, Steller sat on the beach and in approximately an hour penned a summary



Schrader, U.S. Geol. Sur.

▲ KAYAK ISLAND, where Steller went ashore. It lies some miles to the southwest of the mountain that bears his name.



Courtesy U.S. National Museum

of the scientific accomplishments of his first day in America. He listed and described the flora, including upland cranberry, black crowberry, and an exotic new species called raspberry. He recorded the wildlife in detail, describing a magnificent blue bird which was later to be named *Cyanocitta stelleri*, Steller's Jay—familiar to pine-country bird watchers from the Yukon to Mexico. This meticulous set of observations, consisting of more than 144 entries laboriously jotted down in Latin, became the first scientific paper of any kind dealing with Alaskan natural history*.

And the Indians? Bering sent word that if Steller didn't hie himself back to the ship at once, he could remain on Alaskan soil forever. Steller complied.

Summer goes quickly from the Alaskan scene, once August has arrived. As the *St. Peter* zigzagged

through the Aleutians, Steller, ever persistent with pen and journal and keen eye, critically analyzed the behavior of fur seals, sea lions, porpoises, sea otters, and other animals along the way.

Bad Luck

The weather worsened steadily. When Kamchatka still lay many leagues away, the bane of explorers struck Bering and his crew. Scurvy! Long weeks without fruit, fresh meat, or vegetables had brought the men to a disastrous state of debilitation. One by one they lost strength and fell to bed.

With disease mounting and autumn arriving, the expedition leaders bent the *St. Peter's* prow steadily for Kamchatka. Steller must have stood at the bow for many a cold and bleak Aleutian hour, peering longingly into the mists, remembering the rising snow tower of Mount St. Elias and fancying himself deep in the interior, discovering its many

◀ STELLER wrote a lively and informative account of a fifteen-minute meeting with Aleut natives. Noting their resemblance to the Tehukutchi and Koriak people, he promptly deduced their Asiatic origin. It was the first description of Alaskan natives, and this conclusion still stands.

strange, fantastic natural wonders.

Relentless gales and persistent running seas drove the ship off course. Again fresh water ran low, and the ship's kegs turned foul and brackish. Bering veered north, anchored in the Shumagin Islands, and sent ashore for water. Steller went along to bring out antiscorbutic plants and to scout for new wildlife. Here the expedition sighted its first "Alaskans," several Aleuts who approached the ship with great curiosity. Although this brief encounter lasted no more than fifteen minutes (at close range), Steller's subsequent account of it is spirited and remarkably detailed. It constitutes history's first technical knowledge of the Alaskan natives.

Delay in the Shumagin Islands proved almost fatal, and for two weeks the *St. Peter* traveled without sighting land, rolling, pitching, and tossing under powerful storms. "Every moment we expected the destruction of our vessel," said Steller, "and no one could lie down, or sit up, or stand. We were drifting . . . whither the angry heavens willed to send us. Half our crew lay sick and weak; the other half . . . crazed and maddened from the terrifying motion of the ship."

By the end of October, they had passed Kiska and swung north of Attu out into the raging Pacific. Fog and cloud obscured the sun, making navigational observations impos-

*This historic document now rests in the Leningrad Academy of Sciences. Photostatic copies of it are in the U. S. Library of Congress.

sible. On November 6, with the crew exhausted, the ship damaged, and hope flagging, all who could walk or crawl held ship's council.

That dramatic council may well have been history's most fateful hour in the North Pacific. At dawn on the day before, an island had been sighted, and the joyous crew, thinking it to be the Kamchatka mainland, had rejoiced. Now dilemma lay before them: should they land or go on? Aboard ship, conditions had vastly deteriorated. Sailmasts had weakened. Scurvy lay like a pall over the vessel. Winter had arrived.

Bering, himself bedridden, counseled his crew to make a few more leagues to Avatcha Bay—or some outpost of civilization. But their ebbing strength finally turned the decision toward immediate self-preservation, and they turned toward shore. Then they collapsed in utter exhaustion, and Steller alone remained alert as the vessel lurched toward the breakers of this barren island.

The ship was virtually out of control. As she drew closer to the jagged rocks that fringed the bay, the officers rounded up as many crewmen as were able and pulled them on deck to manage the violent landing. Seeing the danger, the crewmen fought desperately with fading strength to keep away from the reef. They pitched an anchor over the side, and the cable snapped. Panic-

stricken, they flung out another, and again the cable snapped. Wind-whipped waves plunged in the darkness toward the ship and broke in thunderous breakers against the rocks. When it seemed that the vessel would be smashed to pieces, a giant wave lifted it miraculously over the reef and into the quiet waters of an inland channel.

Thus did the *St. Peter*, broken and battered by heavy seas, deliver its crew to Bering Island, on which no man had ever set foot. Sea otters

and blue foxes yipped and barked on the beach, and ptarmigan fed on snow-capped ridges inland.

The only available wood was driftwood, and in the days that followed, the crew gathered it and built pit huts along the beach. Owing to the storms that lashed the coast with increasing intensity, it took two weeks to transfer the sick from ship to shore. On November 28, a gale blew the vessel squarely up on the beach.

Soon Vitus Bering succumbed to

Stejneger, courtesy U.S. National Museum



Courtesy U.S. National Museum



▲ STELLER'S TRIUMPHAL ARCH, the west shore of Bering Island where the remnants of the expedition survived a dreadful winter. Steller never relaxed his scientific studies and must have walked through the arch on his journey to explore the northern shore of the island.

◀ STELLER'S HISTORIC DISSECTION of the sea cow, from a reconstruction by his biographer, Stejneger. Steller was the only naturalist to see the animal alive.

➤ THE SEA OTTER, source of the most valuable fur in the world, was abundant in Steller's time. Today, struggling for survival under protective laws.

scurvy and was buried a short distance from camp. But by January, the disease had been arrested, and the survivors, under Steller's care, began their long road to recovery.

At length Steller was free to pursue his explorations in natural history, and on Bering Island he made his most sensational observations. He was the only naturalist ever to see the spectacled cormorant alive, and his eye-witness scientific description remains the only one in existence. Within a hundred years, the bird was completely exterminated by uncontrolled hunting.

He was the only naturalist ever to see, dissect, and describe the sea cow, or northern manatee. This monstrous animal, which has no close relationship to either seal or whale, reached 30 feet in length and weighed 6,000 pounds. Dissecting it was an almost superhuman achievement. With disgruntled assistants, inefficient tools, and the constant depredations of blue foxes slashing at the carcass and destroying what Steller was trying to describe, it's a wonder he succeeded at all. But he did, and this, more than any other accomplishment, places Steller in the naturalist's Hall of Fame. Not long afterward, the sea cow was slaughtered to extinction.

Steller also pioneered the technique of observing wildlife from a "blind." He built a temporary hut

in the midst of the seal grounds and sat in it for days, penning one of the finest interpretations of a fur-seal colony that has ever been written.

As summer came to the island, he described the equally unknown sea lion. Flowers sprang up profusely in the sphagnum marshes and on the tundra, and Steller collected specimens such as violets, anemones, buttercups, cloudberryes, and Sarana lilies.

Meanwhile the *St. Peter's* crew had disassembled the broken ship and built anew. By the middle of August, after nine months on Bering Island, the craft, laden with diminished supplies and increased scientific specimens, sailed from the bay and headed homeward.

Homecoming

Great rejoicing filled Avatcha Bay when the battered remnants of Bering's shipwrecked crew returned. Shortly afterward, Steller left the expedition and plunged into collecting and describing the natural history of the Kamchatka Peninsula.

Within a year, he received instructions from the Academy of Sciences to conclude the Kamchatka project and return to St. Petersburg, collecting along the way.

He never made it.

While botanizing in the interior, he was arrested and hauled to Irkutsk to answer for an argument

he had had with the vice-governor. Higher authorities fortunately rescinded the arrest, and Steller was quickly released. But while celebrating with friends in Tobolsk, he came down with a violent fever and as usual paid no attention to it.

Anxious to be under way, he climbed into a sledge for the 170-mile trip in sub-zero temperatures to Tyumen, much against the advice of his friends. He arrived in Tyumen on November 12, 1746, and fell lifeless before the day was out, at the age of only thirty-seven.

Steller was buried in a shallow grave in hard-frozen ground on the right bank of the river Tura. Eventually the river undercut its banks, carrying his bones away to mingle with the creatures he loved so well and described so faithfully.

No photograph or drawing exists anywhere in the world to show us what Steller looked like. But the legacy he left in his brief eventful 37 years will remain a long, long time.

Linnaeus was right. Who indeed earns more precious glory than he who journeys among barbarians? Today, in America's tall pine country, a breed of happy-go-lucky, black-crested jays bears living tribute to Georg Wilhelm Steller—an eighteenth-century Robinson Crusoe whose dreams of adventure came true.

Robert D. Jones, from U.S. Fish & Wildlife Service





▲ THIS CRACK resulted from the quake. A parallel split is visible in the background.

An Earthquake that Created an Oasis

What seemed like a catastrophe, brought water to desert Indians in Mexico

By ARTHUR L. CENTER

Photographs by the author, from Black Star

EARTHQUAKE! It started with a series of loud rumbling noises on the morning of February 9, 1956, and grew in intensity until dynamic shock waves were being felt hundreds of miles up the California coast and inland into Nevada, Arizona, and Mexico. In Los Angeles and San Diego, downtown office windows were shattered. Plaster walls cracked and buildings

swayed like palm trees in the wind. Before it was over, millions of people in the Southwest had felt the quake. It was one of the greatest rock-and-roll movements of the past 50 years.

On the seismographs it registered a magnitude of 6.8 at the epicenter. This made it the second most violent earth tremor to hit the California quake belt since the well-

known San Francisco catastrophe of 1906. Only the Arvin-Tehachapi upheavals of 1952 were more turbulent.

This geological phenomenon didn't make many headlines across the nation because, fortunately, the most violent shocks were centered south of the border in the sparsely inhabited desert of Lower California, Mexico. Had the center been



▲ EARTHQUAKES are frequent and violent in this area, but never before has one produced water. José Maria Flores, a Cocopah Indian, checks on the overflow of his "miracle" spring.



AN EARTHQUAKE THAT CREATED AN OASIS

located 100 miles to the northwest, on the California side of the border, it is horrible to contemplate what might have happened. As it was, it will always be remembered as a blessing in disguise, though the immediate effects were disturbing. Even upon this monotonous desert plateau in the Sierra de Juarez 60 miles east of the Pacific Ocean, the quake made a startling

change in the landscape in more ways than one. Nothing withstood its tremendous force. It cracked the face of the earth in all directions as though it were an eggshell, snapping roots and cacti in half, uplifting boulders, and shifting large clods of ground several feet. The main fracture, which was parallel to the notorious San Andreas fault, displaced the earth along an

eighteen-mile fissure varying from a few inches to two feet in width and many feet in depth. Rocky cliffs were dropped or raised abruptly to a height measured in feet. In some places entire blocks of soil were so vibrated that they looked like furrowed fields.

In San Miguel, a Cocopah Indian village not far from the principal crack, every adobe house collapsed as though made of toy blocks. Luckily all of the occupants were away in the cotton fields.

Amazingly though, the same tremendous forces of Nature that had reduced every home to a shambles and moved mountains, created an oasis in a waterless wasteland. Like

a miracle, Mother Nature opened up her womb and gave birth to a living spring.

This spring has brought new life to the Santa Catarina desert Indians. Jose Flores, owner of the land, immediately started to channel the overflow into irrigation ditches and clear the surrounding area for farming. With the help of other Indians, he plans to raise corn and beans for his people.

The 100 after-shocks ceased long ago, but the water of this astonishing spring is warm and palatable, and it continues to pour out steadily at the rate of 500 gallons an hour, a living reminder of one of Nature's most whimsical cataclysms.



◀ **JAMES MONTGOMERY** of San Diego and friends mark the main fracture in this picture, which makes clear the unusually large vertical and horizontal displacement of the earth.

▼ **EARTH TREMORS** are not new to this desert region. Here we see what happens to a crack widened by a series of violent earthquakes. At one time the road crossed at the spot where James Montgomery is standing.



John C. Pallister

Ghost Children OF THE Tropics

By JOHN C. PALLISTER

Research Associate, Insects and Spiders
The American Museum of Natural History

One dares not harm GL

THE butterfly collector in the American tropical jungles is sure to encounter one native superstition that he should be careful to respect. This is the poetic and charming belief that certain butterflies are the souls of little children who have died. Jungle Indians capture and use other insects—as food, medicine, pets, and ornaments—but they do not disturb these butterflies and would be deeply offended if any foreigner did.

These butterflies are members of the family Satyridae and are therefore related to our common Satyr and Wood Nymphs. There are several species of them, all in two genera, *Cithaerias* and *Haetera*. They have a wingspread of about three inches. Their wings are transparent; for this reason they are called the Glass-winged Butterflies.

ter·flow'er (-hou'ēr), *n.* = BUTTERCUP, 1.
ter·fly' (büt'ēr-flī'), *n.*; *pl.* -FLIES (-flīz'). [*A*
ège, buttor-flēoge; cf. *G. butterfliege*, *D. b*
erh. named from the color of a yellow species.
CR; FLY.] 1. Any of certain slender-bodied c
cts of the order *Lepidoptera*; — distin from r
OTH, n., 5). The butterflies, which form a divisio
cera, have very large broad wings usually held
er the back or expanded (never folded) when a
ender, somewhat club-shaped antennae, sometim
ear the ends. They are the most conspicuous an
lored of insect
Something resembling a butterfly in appear
ance, or mot. *Specif.: a O* *One can even read*
red, as a cour *Also, one who* *through the clear*
trifler. b Something insubstantial or misty. *wings of the Glass-*
Mach. Show *or BUTTERFLY VALVE.* *winged Butterfly.*
AMNH

tinged Butterflies in American jungles; the Indians regard them as the souls of dead children!

The wings of most butterflies are covered with scales (modified hairs), but the glass-wings have very few scales. These are usually limited to the marginal areas, along the veins, or in small patches on the rear wings, which give most of them a slight color pattern in varying shades of brown and red. The rest of the wings, when viewed through a microscope, show that they are covered with very short fine hairs, each placed where a scale would normally occur. The membrane is so transparent that one can easily read through it.

You come upon these butterflies along very narrow trails in the deepest and darkest part of the Amazonian jungle. Their favorite haunts are in the rain forest where the ground cover is thickest and thousands of young trees are push-

ing upward towards the sunlight.

Like most *Satyridae*, they appear weak in flight. But it takes a quick eye to see them as they flutter along, ghostlike near the ground. Besides their ethereal appearance, they have another characteristic that makes them difficult to collect. They are excellent dodgers. If you fail to net a glass-wing on the first sweep, you will never get a second chance. A flap or two of its wings is enough to take it to the tangled border of the path. To follow it with your net is completely impossible; the ground cover is impenetrable because of interlocking trees, shrubs, and thorny vines. The butterfly will close its wings briefly over its back and glide through a narrow opening, then take another short flap or two and close up to glide again. Usually you lose sight

of the glass-wing the first time it closes its wings and never see it again. Lucky indeed you are if you are able to follow it with your eyes to where it settles, for it almost fades into obscurity.

The Indians are not the only residents of the jungle to regard the Glass-winged Butterflies as the souls of their departed children. Most mestizos and many white persons of the region entertain the same belief. It is surprising how widespread and persistent this concept is throughout tropical America. The insect collector may avoid considerable embarrassment and possible danger by respecting it. While collecting insects in the Peruvian tropics I secured a number of the glass-wings, but I always tried to make sure that no native was near to witness the capture.



Spanish Tourist Department

▲ THE BALLS are found also on the coast of Spain adjacent to Majorca and elsewhere in the Mediterranean.

Beachcomber's Treasure— A SEA BALL

What is this strange object
found on the shores of the Mediterranean Sea —
fish, animal, or shipwrecked cargo?

By ELSIE A. PARRY

WE stood on the beach and looked down at the feather-light, firm, brown ball.

Said the marine biologist: "Well, I'm sure it's not animal, but I don't know what it is."

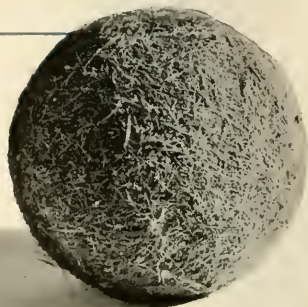
Said the botanist: "It looks like those balls found in the digestive tracts of cows."

Said the layman: "It looks like the innards of a children's ball!"

The botanist was close to the cause of its round shape but was taken aback by the fact that we just picked it up on a cowless, goatless Majorcan beach unvisited even by a camel. The layman's guess might have described its size and appearance but never its performance. There was no bounce in my ball!

The marine biologist was right.

➤ This 2½-inch sea ball weighs less than an ounce. It is a compact mass of very fine fibers.



AMNH

It was not animal. A microscope revealed the telltale structure of some form of plant life. It also revealed that no creature dead or alive was using this ball as a home.

Further research provided the answer. The sea balls are formed of the dead fibers of the ocean sea wrack, *Posidonia oceanica*. This plant is a resident of shallow areas in the Mediterranean Sea and is a relative of the common eelgrass of northern waters.

Early in the winter the plant loses dead leaves; and finally, after persisting for a considerable time, the leaf sheaths are also detached from the plant. It is the threadlike veins of *Posidonia*'s leaves that withstand disintegration and form the sea balls.

Anyone who has ever idled along a beach has watched the seashore debris—small shells, pebbles, and seaweed—being turned over and over by the waves. It is this gentle persistent rolling and turning action, this gyratory movement, that turns the tangled, amorphous mass of dead *Posidonia* into such well-

compacted balls. Their surface bristles with fibers broken short by the action of the waves.

"It is the same action that produces the balls found in the digestive tubes of ruminants, and the hair balls that plague cats!" my botanist proclaimed triumphantly. As a matter of fact, the digestive balls produced by camels can hardly be distinguished in size, form, and color from my sea balls produced by the Mediterranean!

The Mediterranean Sea has long been a producer of fascinating wonders. The sea ball is one of its "Grade B" productions that has been appearing since ancient times. Greek and Roman writers mentioned "bodies" that had been "abandoned by the sea." Galen and Aristotle wrote about using the ashes of sea balls as a cure for serofula, and in 1837 Germain de Saint-Pierre reported that hunters in Provence used the balls to wad their guns. Today, in districts where they are plentiful, sea balls are used commercially in the manufacture of paper and mattresses.

▼ SEPTEMBER BATHERS always find sea balls of interest at Alexandria, Egypt.



BEACHCOMBER'S TREASURE — A SEA BALL

P. Rossi

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The Screen

Authoritative comments on films
in the field of nature, geography and exploration

SECRETS OF LIFE

Reviewed by JOHN C. PALLISTER
Research Associate
American Museum of Natural History
and DOROTHY GOODWIN
Film Editor

THE latest film in the Walt Disney True-Life Adventure Series presents the ever-changing world of nature. Opening with the constantly changing forms of clouds, the scene shifts below to the sea with its continuous tearing down and building up of the coast. Plant growth, the life story of bees and ants, as well as life in the sea and along the shore is then shown. The picture closes with scenes of destructive storms, volcanoes, and other agencies of nature in the remaking of the earth.

Next to the too-loud musical accompaniment, we might criticize the use of too rapid time-lapse photography in recording the growing, budding, and flowering of plants. A false, bizarre impression is thus given when before our eyes

flowers bloom and die in an instant. The lighting of the bee pictures in many instances was particularly disturbing. Back-drop lighting placed individual bees in silhouette, enveloped in a most curious whitish halo, spoiling their beautiful golden color and obliterating their detail and exact movement.

The bee sequence, along with the footage devoted to ants, is the best in the film. It is a pity, therefore, that quite a few grave errors of fact are to be found in the commentary. One of the most serious was the impression given that after a swarm has left, the old colony starts building queen cells. Actually these queen cells are started some eight days before that. Another misstatement was that only the larvae destined to be queens are fed "royal jelly." Actually all larvae are fed royal jelly for the first day or two.

It is to be regretted that *Secrets of Life* does not quite reach the standard set by Disney's best efforts.



▲ A BLACK ANT tries, unsuccessfully, to repulse a snake invading its nest to eat the larvae.

the parent colony, she filled a special pouch in her mouth with a tiny pellet of living mycelium from the parent garden. This was her hopechest, so to speak, and soon after sealing herself in her dungeon, she deposits the precious bit of spawn. Her very life depends upon this tiny speck, and she soon begins fertilizing it with material from her own alimentary canal. At the same time, she commences laying eggs, a few each day. But all of these eggs are not destined to develop into ants, for she eats a part of them to sustain her in her confinement. This is a critical period in the founding of the colony. About once or twice every hour, she picks out a portion of the tiny fungus patch, fertilizes it, and then replaces it. Soon a few of the eggs that she has spared begin to hatch, and she begins feeding her eggs to these tiny larval ants also. Now she has two equally important projects going at once: caring for the mushroom garden and feeding her young. These first young are apparently reared entirely on an egg diet, but all subsequent young will receive only fungus food.

Five or six weeks after the queen began her solitary confinement, the first worker ants emerge from their pupal cases as adults. These are all tiny minims, and they at once take over the work of tending the garden. The queen has passed one important milestone, but she still has a way to go. She is laying a great many eggs, but most of these are still being eaten, since she has no outside source of food. After a week or two more, however, the tiny workers open the door to the outside world and begin collecting small bits of vegetable matter with which to fertilize the beginning garden. The

mycelia now grows faster, and soon the white bromatia food clusters appear.

This is another milestone passed, and from this point on it is merely a matter of more and larger nest cavities, larger fungus gardens, more and more workers of various sizes to carry out the endless labor of the sprawling underground ant city, and finally the production of the soldier caste. This latter caste may not make its appearance for a year or two. We are not sure just how long the original queen-mother lives; perhaps a couple of years. It is known, however, that mated queens are readily taken into the fold. So the colony can, and regularly does, survive far beyond the life span of the queen that founded it.

As one stands among the heaps of earth that are strewn over the ground above one of these great ant cities, one sees very little surface activity. It is only after digging down into the maze of cavities and tunnels that the extent of the colony is appreciated. Beneath one's feet is a profusion of large nest cavities arranged at various levels and in every direction, all inter-connected and extending many feet beneath the surface. There are dozens of surface openings, some of them hundreds of feet from the ant town proper. It is usually from these "feeder entrances" that the leaf-cutting legions emerge to follow well marked trails to the leaf harvesting sites.

Probably it is not generally known that many ants have stridulating organs like crickets and thus make audible sounds. The leaf-cutters have such sound-making organs, and if a soldier, large worker, or queen is held within a few inches of the ear, the high-pitched tone is easily audible. What do the ants use this sound for? Is it a means of communication through the dark, subterranean passages? Perhaps. This is just one of the many things we do not know about these remarkable insects and their ancient "civilization."

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THE BANANA — FROM GROUND TO GROCER continued from page 463

sever the stem a few feet below the bunch of fruit. As the stem bent over, he would steady it with his pole so that the bunch would swing slowly down and come to rest on the shoulder of backer number two.

The backers, who alternated the jobs of removing the props and receiving the bananas, were the men about whom I used to worry. The Costa Rican native is small in size anyhow, but for some unexplained reason the men who were chosen as backers invariably seemed to be pygmies. As a bunch of bananas contains from 70 to 200 pieces of fruit and weighs anything from 75 to 125 pounds, I always expected the poor backer to collapse beneath his load. He stood bravely, however, with one shoulder waiting to receive it and, once the bunch had come to rest, he would wait equally stoically as the cutter with his machete chopped it from

the stalk, perilously close to the pygmy's ear.

Every so often the backer fumbled his catch and it would fall to the ground. When that happened, the entire bunch was abandoned because some of the fruit might have been bruised. The cutter would then look disgustedly at his helpers, the helpers would look unhappy, and only Sam and I were pleased, because this meant that in a few days the bananas would ripen in the heat and we would be able to gorge ourselves.

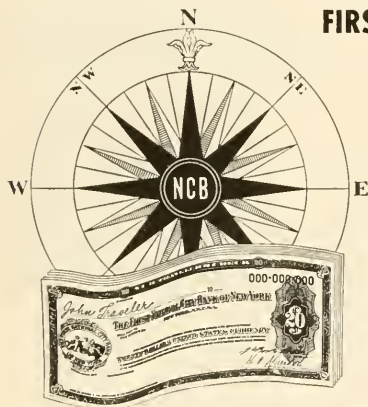
It was almost our only opportunity to sample the fruit, which was rarely to be encountered in Palmar off the tree. People working on a banana plantation, I discovered, are as little interested in eating bananas as a candy saleslady is in eating chocolate creams.

The cutting gang used to yell wildly as they approached their objective. Their cries, sounding like

a cross between a coyote and Ezio Pinza, could be heard for miles and never failed to chill my blood. There was no way of telling when this weird bacchanal was about to take place, as the day for cutting bananas varied, ten days or two weeks sometimes elapsing between operations.

"If only I knew ahead of time when mayhem was to be committed, I wouldn't be so startled," I chided Mr. Copper. "After all, irrigating and spraying each take place on a fixed day each week. Why can't the cutting be as well organized?"

Mr. Copper gave me the patient look he had doubtless developed since I first started asking questions. "The cutting takes place when we have been notified that one of our ships will be ready to take on a load in the near-by port of Golfito," he explained. "I get word that there will be room for 40,000 bunches, let's say, or per-



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haps 60,000. As I am always kept informed as to which farms are prepared to supply the cargo, I give advance notice to the foreman of each of those farms about how many bunches he is expected to furnish. The men begin cutting at dawn, and then the bananas are sent down to Golfito as quickly as possible so that they won't spoil. Tomorrow happens to be a cutting day," he added, "and if you like, I'll take you to watch the procedure."

The following day, Mr. Copper and I toured various farms. Some of the older ones had no roads, and we walked along narrow mule paths to see a succession of pack mules patiently waiting to be loaded with two huge bunches of bananas apiece before they were led away. Most of the farms, however, were criss-crossed by an elaborate series of automobile roads, making it possible for motor trailers to follow the cutting gang closely until the trucks were heaped high with fruit.

Each farm had its branch railroad with a miniature depot where mules and motor trailers dumped their loads. Here, under the watchful eyes of the foreman, who discarded any bunches that didn't please him, each bunch of bananas was hooked onto a pulley and dipped first into a solution to remove the Bordeaux mixture and then into a tank of water to remove the cleanser, after which it was swung into one of a series of railroad cars that had been completely lined with banana leaves to protect the fruit.

"And now what?" I asked Mr. Copper, when the cars had been filled to overflowing.

"Now," said Mr. Copper, "the cars wait here for an engine to come along and pick them up. The engine goes from farm to farm until it has collected about 75 cars, after which it takes them down to Golfito. Of course there's more than one train," he added. "Picking started at dawn, and bananas are probably being loaded on the ship right now."



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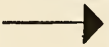


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As there was no room for another banana, much less a person, in the bulging railroad cars, I was unable to follow the rest of the operation until some months later when we sailed from Goltito on a cargo ship.

The cargo ship in question was called the *S.S. Metapan*, and she was due to sail at 7 A.M. We boarded her the night before, and I watched the loading until the early hours of the morning, partly out of curiosity, partly because the noise made sleep impossible. Men yelled, railroad cars rattled, whistles blew, more men yelled. A cargo of 40,000 bananas can be put aboard in about 12 hours, and the job apparently went more expeditiously when the men used their lungs as well as their hands.

The banana train stood alongside the ship while a crew of workmen handed out the fruit, bunch by bunch, to the backers, who transferred it to a circulating conveyor belt made up of an endless series of canvas pockets. The operation had a certain rhythm, each bunch of bananas proceeding in turn from unloader to backer to a pocket of the continuously moving belt. Occasionally a pocket was missed and went on its way empty due to (1) a tarantula being discovered in the fruit (screams), (2) an inspector disliking the looks of a particular bunch (hoots), (3) a backer slowing up, his mind perhaps on higher things (Bronx cheers). The belt carried the fruit into the refrigerated hold, where the same process took place in reverse, the bananas being removed from the canvas pockets by an unloader onto the shoulder of a backer and then carefully stowed in the storage room.

We finally sailed at 10 A.M., and I turned over on my hot bed, thinking enviously of the bananas in their air-conditioned quarters and muttering, as I finally fell asleep, the slogan which some unkind soul invented to describe the policy of the Fruit Company: "Every banana a guest, every passenger a pest."

Eight days later when we landed in New York, we carefully made our way through the elaborate apparatus already set up on the dock to take care of the *Metapan's* precious cargo. Trucks were lined up to transport the fruit to near-by storage houses, especially ventilated railroad cars were ready for its delivery to distant cities. A conveyor belt was being put into operation to bring the bananas up from the hold, while inspectors waited to pass on their condition.

On board the ship I had learned about the final disposition of the fruit. The first day out, the steward brought us an invitation to sit at the captain's table, a gesture I found highly flattering until I discovered there were only two other passengers on board, both of whom had been similarly honored. I did sit next to the captain, however, and by asking innumerable questions, was able to follow the bananas on the last step of their journey.

In most of the large cities of the United States, I was told, special warehouses had been constructed to take care of the fruit. In these, different rooms are kept at different temperatures, so that the bananas can ripen either slowly or fast, according to the orders received. If the market is good, the heat is increased; if the public is temporarily blasé, temperatures are low-



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ered until the public's banana appetite reasserts itself. "Grocers," explained the captain, "call up the various warehouses to leave their orders and the fruit is allowed to ripen accordingly."

"What happens if a hurry call should come in?" I asked him.

"In that case the fruit can be ripened very quickly," he said.



"Temperatures are stepped up, the bananas are sprinkled with warm water and gas is applied to give them color."

Somehow it sounded like cheating. "But do they taste just as good?" I asked doubtfully.

"Just as good," said the captain, pushing aside the bananas and carefully selecting an apple from a bowl in the center of the table.

I knew just how he felt. For months my life had been linked so closely with the golden fruit that it was some time before I could bring myself to eat a banana with any enjoyment. It was too much like biting into a personal friend.

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YOUR NEW BOOKS continued from page 455

know, this oceanarium is an ocean-sized aquarium which contains samples of the mammalian, fish and plant life of the sea, the like of which has never been assembled before. In a unique spirit of showmanship and scientific investigation, Marine Studios, Inc., brought box office appeal to the support of oceanography. Happily, this book reports, the venture is at last a profit-making enterprise. Its success has stimulated the establishment of other oceanariums at Palos Verdes, near Los Angeles; at Coney Island, where the New York Aquarium is to take a new lease on a larger life; and perhaps at Monaco, on the shores of the Mediterranean.

The two huge tanks at the Marine Studios Oceanarium make it possible to give the public a close-up view of some of the larger animals of the sea. From the deck and through the portholes around the sides of the tanks, the visitor can become acquainted at close and comfortable quarters with the intimidating barracuda, the moray eel, the ray, the octopus, and a half dozen different kinds of sharks. The tanks at one time even contained a whale. But the biggest surprise, by far, is the reader's and the visitor's introduction to the por-

poise: "... a superior animal with a sense of humor, curiosity and imagination more highly developed than that of the dog." At feeding times, which are scheduled with an eye on the gate, the porpoises put on performances which would challenge even the highly developed imagination of P. T. Barnum. They pull riders on aquaplanes, toss basketballs through the ring, put out fires with artful splashes of their tails, ring bells, hoist flags, and leap spectacularly through hoops held high above the water.

These big animals share the tanks with more than a hundred other varieties of marine life. There are butterfly fish, the surgeonfish, and triggerfish, the brilliant sergeant major, and the parrotfish. The sharp-eyed visitor will see the presumably stationary anemone crawling about on the bottom of the tank; the reader of the book will learn that one species of hermit crab provides this transportation for the anemone in exchange for camouflage and protection. The sea slug will be seen wearing a kind of fur piece of waving tendrils. These, the reader of the book will learn, are the stinging cells of an anemone; the sea slug, immune to their toxicity, has devoured the anemone and adapted the stinging cells for its own ends.

These and many other out-of-the-way experiments of natural selection live successfully together in the strange ecology of the oceanarium. The total picture is a less than accurate reflection of life in the sea itself. Regular feeding by the hand of man breaks the predatory chain of nature, and the barracuda lies down with the angelfish.

Though nature is thus modified in the environment of the tank, the oceanarium has made research possible along a half dozen new lines. Here again, the porpoise is the star performer. Its life cycle has now been recorded at close range and its rich repertory of behavior intimately observed. Among other things, the porpoise has been found to have a rare faculty: it can emit and hear sounds in the ultrahigh-frequency range and may thus, like the bat, employ the echo-sounding principle for navigation in the murky shallows and close quarters where it feeds. Investigators of animal behavior have found that the pecking order prevails even among the biologically primitive sharks. The octopus, as a maze-runner, has demonstrated rudimentary memory. On a more immediate practical level of investigation, workers at the oceanarium have developed a shark repellent, new techniques for fish tanning and, above all, new ways to maintain aquarium collections in teeming, robust health.

The reviewer is editor and publisher of Scientific American.

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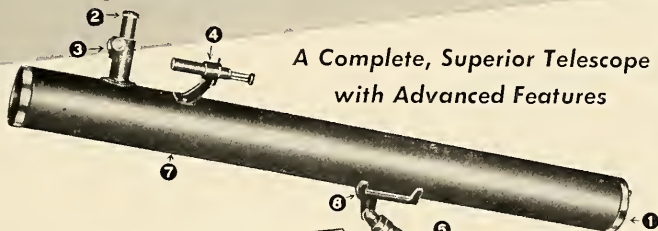
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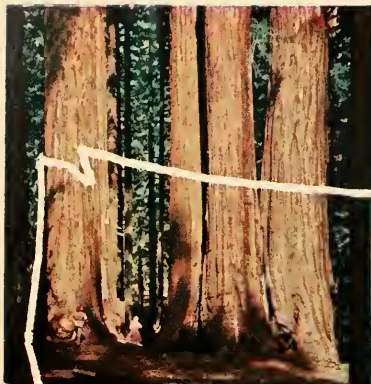
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THE MUSEUM SHOP

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Letters

Is a Rose Within a Rose, Still a Rose?

SIRS:

One generally finds the stamens and pistils of a rose surrounded by the colorful petals. What was my surprise one day to find instead another rosebud growing from this center. It finally developed into a full-blown blossom, and the petals of the blossom from which it had sprung took the usual course of roses—they shriveled, dried, and fell.

The accompanying photo shows it while still a bud, growing from the original blossom. Other blossoms developed and bloomed on the same bush in the usual way. This was the only one that took this original course.

KAY COGGIN

Chalfont, Pennsylvania

For help on this question we went to our botanist, Dr. Jack McCormick, who has supplied the following information:

At the apex of the stem of a growing plant there is a region in which rapid cell division occurs. As the cells produced in this region mature, they become specialized into various parts of the stem. Periodically, a few cells retain their rejuvenative properties and become organized into new regions of division from which come cells of leaf or flower tissues.

In the rose, as in many plants, even after the flower parts are fully formed, the tiny growing point remains intact but its activity is greatly reduced. An injury or some internal stimulus causes the cells of the growing point to again resume active division. This may result in multiplication of flower parts—petals, stamens, pistils. Or a new stem with entirely distinct leaves and flowers may be produced. Mrs. Coggin's rose is an example of the latter condition.

Malformations and monstrosities occur sporadically in all kinds of living organisms. Proliferous roses, in which one flower develops from the center of another, are examples of floral monstrosities. Such growths are not infrequent, but are rarely reported. The photograph submitted by Mrs. Coggin brought to mind an even more spectacular example of rose proliferation, which we reproduce here from a book by Maxwell T. Masters, published in London in 1869.

Shark Repellent

We have received a number of letters in response to the shark repellent story ("Victory over the Shark") in the September issue of NATURAL HISTORY. Mr. H. Nelson Slater writes from Europe, "We were so interested in the article... that I am writing to ask where and how we could obtain the proper prescription for



the preparation of 'copper acetate.' As we frequently swim in waters where there are known to be sharks, I would very much appreciate having the opportunity of at least benefiting, psychologically, from this discovery."

From Honolulu, Hawaii comes a letter from Mr. Charles A. McWayne, Jr., Vice-President of McWayne Marine Supply, Ltd., ship chandlers: "I have read with interest the article 'Victory over the Shark.'... We have been purchasing shark repellents for sale from a manufacturer who has now gone out of business.... The majority of our requirements have been with the Civil Aeronautics Administration who have an urgent need for shark repellent in connection with their work throughout the Pacific Ocean area. Strangely enough, the Civil Aeronautics Administration, as well as other U. S. Government agencies in the Pacific, are unable to secure shark repellents. We are, therefore, wondering if your office or the author could furnish us with the name of a manufacturer of the repellent."

W. S. Weaver writes us from California: "Ralph Hill's interesting article meant a great deal to me. In Catalina in some places we are bothered by Blue Sharks, and since I am a constant swimmer and know the unpredictability of a shark, I wonder if you could tell me where I might



get some packages of shark repellent. The Navy might have the shark licked, but we 'Islanders' haven't!"

The prescription for the repellent is not available, but the Shark Chaser Chemicals Company, 413 West 7th Street, San Pedro, California, manufactures and sells the repellent on a retail basis.—Ed.

Fish Prints

SIRS:

Not only did I enjoy the article, "Picture the Fish" in the October issue but it suggested something to me. My husband is a Navy chaplain serving at a remote island station and had put to keep the ship's crew amused. Last year my husband tried fish taxidermy on an especially interesting catch, but someone threw his treasure overboard feeling that perfect preservation had not occurred! The making of fish prints might interest these men. Can you tell me where my husband can write to order the proper paper and ink?

BARBARA W. McPHERSON

Grosse Point, Michigan

Any large artist's supply store can supply the paper and ink for making fish prints. Readers lacking such a source can order from Arthur Brown, Inc., 2 West 46th Street, New York 36, New York.—Ed.

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December, 1956 Volume LXV, No. 10

Navaho Herders Cover Design

From a color transparency by Josef Muench

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Can shipwrecked men survive if they drink sea water? How can its salt content be removed? Scientific research tries to supply the answers

The Wonders of Water John H. Daugherty 518
We take for granted the substance on which all life depends, yet it has more strange properties than any other common fluid

Nature's Moth Killer Harold V. Green 520
The Ophion ichneumon fly operates its own fifth column movement — it shoots its eggs deep within the Polyphemus moth's larvae, and the grub that emerges eats its host alive!

The Hamster Changes to Winter Oil Paul O. Chatfield 523
In the secrets of the hibernating animal may be greater safety for the patient undergoing heart and brain surgery

A Study in Scales Samir Sen 524
The strange-looking pangolin comes equipped with its own protective armor — a coat of hard, brownish-gray scales!

Is There Life on Other Worlds? Gary Webster 526
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Cinnamon — Spice that Changed History Alice L. Wood 532
Some of the most hazardous and adventurous trade routes in history were pioneered in the name of cinnamon

Afghan Profile Louis Dupree 537
An expedition to excavate the past leads to some fresh glimpses of a land from which American correspondents have recently been excluded

The Cave of the Guacharos Jeanne and Russell Gurnee 542
Want to explore a cave? This one in Venezuela holds thrills enough — a water passageway, awesome caverns piled high with beautiful mineral formations, and last but not least — strange, nocturnal birds that leave the cave only at night for food

The Beautiful and Deadly Arthur C. Clarke 548
The Scorpion Fish, one of the most dangerous in the sea, is also one of the most beautiful — and approachable!

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You will find NATURAL HISTORY Magazine indexed in Reader's Guide to Periodical Literature in your library



THE COVER THIS MONTH

Sheep have become so closely identified with the seminomadic Navaho Indians of Arizona and New Mexico that it is difficult to imagine these tribesmen without their flocks. Yet the ancestral Navaho once lived by hunting and part-time farming. They did not acquire sheep in any numbers until late in the seventeenth century, after the Pueblo Indians had revolted against their Spanish conquerors. Many Pueblo families, fearing retribution, went to live with their Navaho neighbors, bringing their sheep, and the techniques of sheep herding which they had learned from their European masters. Additional sheep were stolen from Spanish ranches of the Rio Grande valley.

These were the beginnings of the Navaho flocks, and sheep soon revolutionized Navaho economic life. Though the men continued to hunt and raid, the women were the shepherds from the first. They also did the farming and weaving, and became the pillars of Navaho economy. The needs of the flocks even dictated the typical Navaho social unit — the isolated family group illustrated on this month's cover.

HARRY TSCHOPIK, JR.

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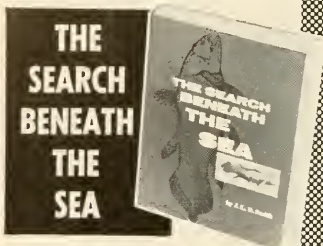
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SPRING ON AN ARCTIC ISLAND

----- by Katherine Scherman

Little, Brown, \$5.00
331 pp., illus.

Reviewed by

MARIE PEARY STAFFORD

IN 1954 eight Americans, sponsored by the New York Zoological Society and the Arctic Institute of North America, spent 6 weeks 450 miles north of the Arctic Circle on Bylot Island studying its wildlife. The reason for choosing such a little-known spot is explained by the author: "The comparatively low number of species and the clearly visible relations between them in this open, undisturbed land made Bylot Island an ideal choice for a short-term ecological study."

Frankness is one of the author's most endearing characteristics. She makes it plain at the outset that she and her husband are "amateur ornithologists," that her story is a personal record of an unusual adventure, and that whatever scientific information she gives has been gleaned from the five bona fide scientists in the party. She is also scrupulously careful, in speaking of the Eskimos with whom she became acquainted, to limit her observations to the small group of Baffin Island Eskimos who visited and travelled with the scientific group during its short stay in the Arctic.

There was one other woman in the party, the wife of Doctor Drury of the Biology Department of Harvard University, and it would be interesting to hear her account of this same expedition, because either Mrs. Scherman is a determined idealist and outstanding "good sport" or she is an iron woman. In speaking of the camping place eventually chosen as headquarters during the six weeks' stay, she writes: "Our lagoon looked pure, blue, and sparkling in the evening sun, but it was the favorite feed-

ing and sleeping quarters of snow geese and glaucous gulls as well as the habitat of numerous visible small water creatures and heaven only knew how many millions of invisible ones. Its water was not only teeming with life but had an unpleasant yellow tinge in a cup. We closed our eyes and drank it."

Later, after telling of the frustration experienced by the party in trying for days to get the Eskimos to take them from Pond Inlet to Button Point, to which the Eskimos agreed but made no move to go, she tells how, without any warning whatever, one evening at six, the sledges started. She was, of course, completely unprepared. With her arms full of cameras, blankets and equipment, she made a leap for one of the sledges, missed and fell flat on her face in the snow. She says "The Eskimo driver stopped his dogs and giggled while I collected myself. I couldn't do anything but laugh too."

There are other things which are also difficult to understand in Miss Scherman's story, chief among them being her insistence that these Eskimos are living in "the springtime of mankind," that they are the last living remnants of the Stone Age and for this she greatly admires them. She speaks of them as "sophisticated and subtle"; she finds them "man at his best, in perfect balance with nature, unafraid of death or misfortune, gay, quick-witted and courageous." Yet these Stone Age men have cameras, repeating rifles, outboard motors and one of them kept a diary and another had inherited \$10,000 from his father!

However, these points, although they occur and re-occur throughout the book, are mere quibbles. The author is extraordinarily observant and is extremely aware of the beauties of nature in all its phases. She has remarkable powers of description and her word pictures of the tundra, its bird life and its subtle flowering are unforgettable. So, too, are the interesting bits of information she gives on

the effect of the permafrost on plant life and the intricately interwoven causes and effects of the lemming cycle.

In spite of the author's optimism and idealism, there is a sinister undercurrent to her story. On the one hand there are the Eskimos, who she says quite frankly are a dying race, soft, unable to see the dangers of the white man's civilization. In the old days when a man hunted only to feed his family, he needed only a few dogs to pull his sledge. Now, when hunting and trapping for the white man has become the chief means of livelihood, the Eskimo needs a much larger team, and hunting to feed them occupies the greater part of his spare time. More and more he comes to depend on the white man's food, his modern conveniences and his money.

The other side of the picture concerns the white man in the Arctic. One of the most delightful characters in the book is Pete Murdoch, the young Hudson's Bay Factor at Pond Inlet. Charming, friendly and always helpful to white strangers, he was kind, and just as understanding to the Eskimos. He was in his early twenties and although happy and contented in his work, he felt it was time for him to go out in the world and mix with his own people. What happened? For eight months he was discontented and miserable, an obvious misfit. Now he is back in the North again where he will prob-

ably remain. The two different types of civilization do not mix. It is obvious that to be fitted for one disqualifies a man for the other.

All in all, this is a charming book, easy to read, fascinating in its descriptions of a land and a way of life completely different from that which the ordinary reader is ever likely to experience. But it takes someone like Mrs. Scherman to get the most out of living it and to describe it adequately.

The reviewer, daughter of Admiral Robert E. Peary, discoverer of the North Pole, was born in Northern Greenland.

BRING 'EM BACK PETRIFIED

----- by Lilian Brown

Dodd, Mead, \$4.00, 277 pp., illus.

Reviewed by ELEANOR LOTHROP

IN *Bring 'Em Back Petrified*, Lilian Brown tells the story of a season in the jungles of Central America where she accompanied her husband Dr. Barnum Brown, noted paleontologist, in his search for fossil remains of the great animal migrations of the Ice Age. The Browns spent approximately six months in and around Santa Amelia, a native village in

the province of El Peten in Guatemala, and a double theme is interwoven throughout the book—one, the scientific search for fossils, the other, a chronicle of the people of Santa Amelia.

Santa Amelia was picked as headquarters because a native hunter had discovered fossil bones in the vicinity. This remote little village had an air strip where a small plane landed the Browns and the provisions for their expedition. It had little else in the way of conveniences. The natives, however, were for the most part a happy, carefree lot and, considering their isolation and consequent unaccustomedness to foreigners, they adapted themselves amazingly quickly to their visitors. The men and boys vied for jobs to assist Dr. Brown in his hunt for strange bones.

Dr. Brown's quest was remarkably successful, particularly considering that, according to the author, "Looking for bone in the jungle . . . simply isn't done." His methods were frequently unorthodox, but they paid off. Thus his most productive finds came as a result of persuading the workmen to dive into the river to retrieve fossil bones, their enthusiasm being kindled by the device of totting up individual finds on a blackboard with a bonus paid according to the score. Bits of mastodon, ground sloths, camels, and prehistoric horses and bisons were salvaged in this way, confirming Dr. Brown's theory that

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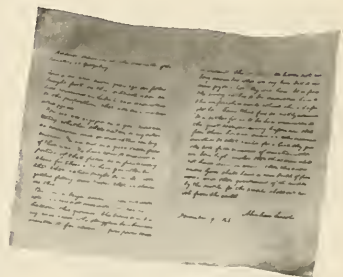
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he was "sitting on their (the great animals') old line of migration."

Mrs. Brown was equally successful in her own field—keeping house for her husband and making friends with the natives by ministering to the sick and doling out the expedition's tinny supplies to the needy. Only Kaa, an old hag who for years had officiated as witch doctor and who held the community under her thumb through fear, refused to be won over. The other inhabitants—adults, children, even dogs—became the couple's fast friends.

Mrs. Brown touches briefly on neighborhood archeological discoveries and devotes a few chapters to the excavation of a Maya temple. If the Browns' methods of work in this field—haphazardly pulling bits of pottery and obsidian out of the ground and occasionally pocketing museum specimens—would cause an archeologist's hair to stand on end, by the same token an archeologist would probably find himself at a loss if confronted with the tooth of a giant sloth.

If there is any quarrel to be had with the author, it is a slight skepticism at her unflinching good humor, untroubled even in the face of being trapped in thorny jungle growth (from which she was only extricated by a drastic haircutting job); or at the influx of dirty children, dogs, turkeys, and pigs with (as an undoubted sequitur) fleas, lice, and ticks, into her living quarters. As an "expedition wife" herself, this reviewer may be jaundiced, however, by

her own experiences and possibly envious of a disposition apparently so much better than her own.

At any rate this is minor criticism, for Mrs. Brown's book is interesting throughout. Her story of the people of Santa Amelia is vivid reading, and her description of the jungle country is superb. Illustrations by H. Lawrence Hoffman add an amusing touch to the book.

Eleanor Lothrop has accompanied her husband on many of his archeological expeditions to Central and South America and is the author of *Throw Me A Bone* (1948).

FORMS AND PATTERNS IN NATURE

by Wolf Strache
 Pantheon, \$7.50
 100 pp., 88 illus.

Reviewed by
 ROGER L. CROSSGORE

FOLLOWING his thesis that "nature uses the same ideas in her forms and patterns in quite different places," Dr. Strache proceeds to juxtapose a selection of photographs covering such areas as the sky and earth, the minerals, the plant world, and the animal kingdom in a handsome book. It does more than prove his point. It takes the reader on a fascinating visual journey through the world of nature where the majority of places visited are

AERIAL photo of a creek system in a shallow portion of the sea, from *Forms and Patterns in Nature*.



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The reviewer, an art instructor, specializes in the teaching of Nature Structure at Pratt Institute.



AMERICAN WATER AND GAME BIRDS

----- by Austin L. Rand
Dutton, \$11.50

240 pages of text, 167 photos,
35 silhouettes by Ugo Mochi

Reviewed by

ROBERT CUSHMAN MURPHY

HERE is another gorgeous picture book designed to complement an earlier production of the Chanticleer Press entitled *Land Birds of America*. The present volume contains 130 reproductions of color photographs by the Cruickshanks, Porter, La Tour, Hosking and other virtuosi of the camera. Many figures are enlarged almost to the size of the nine-by-twelve-inch page and, with a few exceptions, they faithfully render the hues and difficult gradations of plumage. Only here and there, as in the case of the California quail, is the result a bit off-color. The flamingo portrait represents a captive bird—though not so stated—and it lacks the brilliant rose of this West Indian species in the wild.

There are also 70 black-and-white photographs of high merit and usefulness. One of them, a wedge of flying snow geese by Kubichek, has been printed upside down. An additional decorative feature of the book is a series of clever silhouettes by Ugo Mochi. The artist is, however, less familiar with the extraor-

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dinary subtleties of bird conformation than he has shown himself to be with those of mammals. Some of his cut-outs are pleasing and convincing, whereas others (the tropic birds, for example) bear little resemblance to the visual impression of the living subject.

The text does much more than merely explain the meaning of the pictures. Dr. Austin Rand, Chief of the Zoological Section in the Chicago Natural History Museum, has done a thoroughly competent job. He has perhaps overemphasized the relative dimensions of species within a group, because a volume of this kind is hardly likely to be much used in field identification. But he has succinctly recorded the habits and outstanding characteristics of the bird families and their species, including much information derived from very recent research by himself and others. It is a pleasure to see such a student of animal psychology as Dr. Rand forthrightly label the broken-wing behavior of certain nesting birds a "rise." This reaction has been the subject of intensive study and differing interpretations. The fact that it works in saving eggs and young from predatory enemies shows, nevertheless, that it is a "purposeful" adaptation even if neither voluntary nor deliberate. The text throughout is a sane and forceful plea for stepped-up activity in protecting natural resources on our continent. Unless we do this we shall certainly lose many more of our birds.

The reviewer (Lamont Curator Emeritus of Birds at the American Museum of Natural History) is a leading world authority on birds and author on the subject. His works include *Oceanic Birds of South America*.

IN SEARCH OF ADAM:

The Story of Man's Quest for the Truth About His Earliest Ancestors

by Herbert Wendt

Translated from the German

by James Cleugh

Houghton Mifflin, \$6.50

540 pp., illus.

Reviewed by
THEODOSIUS DOBZHANSKY

AN attempt is made in this book to present in a lively and readable form the history of the evolutionary idea, particularly as it concerns the origin of man. A great deal of historical ground is covered, from Aristotle to the year 1953, and from the "dragon teeth" to the African australopithecine remains. The author is a free-lance writer and journalist who, without resorting to a "journalistic" style, skillfully calivens his narrative by dramatic or amusing details of the lives of those who have presented us with theories, or

continued on page 552

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WESTERN WONDERLANDS

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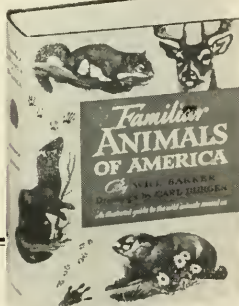
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THIRST

Can shipwrecked men survive
if they drink sea water?
How can its salt content
be removed?
Scientific research tries
to supply the answers

By WILLIAM H. ALLEN

ONE very hot day in July, 1943, Lt. (j.g.) George H. Smith of the United States Navy was sitting on a small rubber raft somewhere between Munda and Guadalcanal. He was very thirsty, and he was cursing man's inability to drink sea water. To his surprise, he saw a booby bird land on the surface, put its long neck under the water, and apparently take a drink.

In Smith's own words, "It made me mad. I couldn't understand why the bird, which was only flesh and blood like myself, could drink sea water while I couldn't."

Smith's next reaction was the crucial one. Though under all the strain of a life-and-death predicament, he set himself a plan of scientific investigation.

"I shot the bird," he relates, "cut him open, and traced the course of the water through his digestive system. Around the intestines of the bird I found a handful of fat,

and I reasoned that if I greased my mouth with this fat, I might be able to swallow sea water without tasting it. For five days then I drank a pint of sea water each day."

Lt. Smith was picked up after 20 days afloat, still in fairly good physical condition.

Smith's story was widely circulated. His procedure for making sea water drinkable, and the fact that he had drunk a pint of it a day, were even incorporated into survival instructions used by some Navy and Army Air Force crews. Soon, however, less optimistic reactions began to be expressed.

Articles appeared in service publications pointing out that men are not booby birds and that drinking sea water as Smith had done could kill a man. U. S. Navy medical authorities reported that the reason Smith had suffered no ill effects from five continuous days of imbibing sea water was that he was not seriously dehydrated at the be-

ginning of the ordeal and that on the fifth day a rain squall provided him with all the fresh water he could drink. If he had been dehydrated when he started or if the rain squall had not come when it did, he might have lost his life.

Smith himself had noted that the amount of water he lost in urine during the five days was apparently three times the quantity of sea water he drank. Obviously, excretion of the salts in the sea water was taking water from his body, and he would have been dangerously dehydrated if he had continued drinking sea water.

Unfortunately, the medical reports on the incident were not read as widely as the original report, and Smith's experience is still cited by some survival "experts" as proof that man can survive at sea without fresh water.

Recently several newspapers and magazines of large circulation have carried stories purporting to "prove"

that it is safe to drink sea water. Most of these stories are based either on the account of Dr. Alain Bombard, who drifted from the Canaries to Barbados in his raft *L'Hérétique* in 1952, or on the experiments carried on by the French Navy, which are essentially a continuation of Bombard's work. The French experimenters now maintain that a man can survive for six days by drinking only sea water. But he must drink it in small quantities—approximately one-tenth of a pint (50 c.c.) at a time. If sea water is to be drunk beyond the sixth day, the French say that the survivor must drink 1000 c.c. (1.05 quarts) of fresh water on the sixth day to help get rid of excess salt.

In short, it is claimed that the survivor could live for eleven days on little more than one quart of fresh water, although this claim has not been subjected to experiment. Unfortunately, many of the stories written about the French experiments omit any mention of the restrictions on the use of sea

water and leave the reader with the impression that the sea will provide all the water a man needs for an indefinite period.

The U. S. Naval *Acro-Medical Safety Journal* stated in 1955 that "all physiological knowledge at present indicates that sea water is inimical to the human organism and that its use will shorten rather than prolong survival time." This view has been repeated in other official Navy publications. The U. S. *Air Force Manual 64-5* entitled "Survival," which is carried in all Air Force survival kits and on many commercial airplanes, says: "Do not drink sea water."

Why do the services take this stand? Is it due to the natural reluctance of medical men to accept a theory that has not been thoroughly tested? Or is it because the theory has been tested and found wanting? The fact is that the problem of providing water for the survivors of shipwreck and aircraft ditchings has been thoroughly investigated, and the investigators

have found that the use of sea water is not the answer.

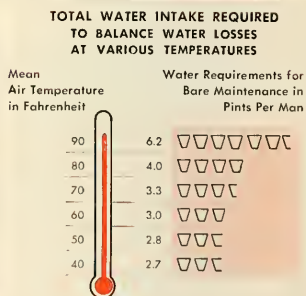
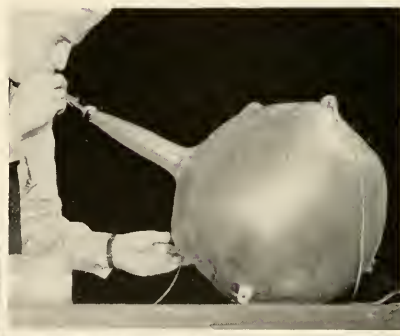
During World War II, the armed forces and the merchant marines of all the combatants were faced with the problem of providing seamen and airmen with a supply of water in case of disaster. This problem posed many questions, the first of which was: How much water does a man need in a survival situation?

The standing rule of thumb used prior to World War II on board naval vessels and merchant ships was "a pint a day per man." However, tests on subjects placed in a simulated survival situation soon showed that this was not enough to keep a man in water balance. Different investigators came up with different answers as to the exact amount of water needed to prevent dehydration, but all agreed that the minimum amount was a great deal more than a pint a day.

The following table, compiled by Dr. E. F. Adolph and his associates, gives the values generally accepted by the end of the war.

A SOLAR STILL can produce two pints of fresh water from sea water a day. Deflated it occupies the space of a pint can of water. Some U. S. Navy planes carry the model being used below.

U. S. Navy



A team of United States scientists directed by Dr. Adolph went even further and estimated the relationship between total water supply and survival time at various temperatures. Dr. Adolph computed that at environmental temperatures under 70 degrees F., a man who starts out in water balance can survive for ten days. These values apply to an inactive man, in the shade, and with a low calorie intake.



Wide World Photo

▲ DR. ALAIN BOMBARD and raft (above and right) used in his 65-day experiment to prove shipwrecked men can survive on fish and water.



United Press

Note that the advocates of drinking sea water claim only that a man can survive for six days by drinking sea water alone and for eleven days if he drinks slightly over one quart of fresh water while drinking sea water. Thus it appears that by drinking no water at all a man would survive for four days longer than he would on sea water, even if the claims of the advocates of sea water are valid.

The data for environmental temperatures of 70 degrees F. and under are used in the example above because all the sea water experiments recorded have been carried out in temperate and cool climates. As is shown in the table below, expected survival time goes down sharply at higher temperatures, even if the subject can remain in the shade.

The accuracy of Adolph's predictions has been borne out several times in actual survival incidents. An extensive study of shipwreck survivors during World War II showed that the maximum time without water recorded by any survivor was eleven days—just one day longer than the prediction.

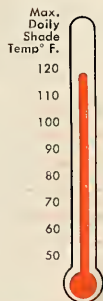
Adolph also demonstrated that, as the body becomes increasingly deficient in water, certain symptoms follow in order. The degree of dehydration was rated by measuring the per cent loss of body weight. At the beginning of dehydration there is thirst and discomfort. Succeeding symptoms, in order, are lassitude, loss of appetite, sleepiness, rise in body temperature and, at about 5 per cent dehydration, nausea. At from 6 to 10 per cent dehydration, the victim

will experience dizziness, headache, tingling in the limbs, dry mouth, difficulty in speaking, and inability to walk. At more than 10 per cent dehydration, delirium is common, and the senses fail. Dehydration of 25 per cent is probably fatal at any temperature. At air temperatures above 90 degrees F., 15 per cent dehydration is the theoretical fatal limit.

Yet records of shipwreck survivors show that very few die of dehydration alone. MacDonald Critchley, a British physician who made an extensive study of the factors affecting survival at sea, believes that as dehydration increases, the victim's will to resist the desire to drink sea water weakens until finally he succumbs to the temptation and death is caused by the ingestion of sea water. Critchley says, "Sea water poisoning must be accounted, after cold, the commonest cause of death in shipwrecked sailors."

Critchley tells what happens when a very dehydrated person drinks sea water. There is "immediate slaking, followed quite soon by an exacerbation of the thirst, which will require still more copious draughts. The victim then becomes silent and apathetic, with a peculiar fixed and glassy expression in the eyes. The condition of the lips, mouth, and tongue worsens, and a peculiarly offensive

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Max. Daily Shade Temp° F.	With no water	With 1 qt.	With 2 qts.	With 4 qts.	With 10 qts.	With 20 qts.
Days of Expected Survival						
120	2	2	2.5	3	4.5	
110	3	3	3.5	4	5	7
100	5	5.5	6	7	9.5	13.5
90	7	8	9	10.5	15	23
80	9	10	11	13	19	29
70	10	11	12	14	20.5	32
60	10	11	12	14	21	32
50	10	11	12	14.5	21	32

From E. F. Adolph's *Physiology of Man in the Desert*



▲ MANY AIRLINE COMPANIES provide desalting kits as part of survival equipment with rubber rafts carried by commercial planes.

➤ THE KIT CONSISTS of cakes of silver aluminum silicate and a plastic processing bag.

▼ THE PROCESSING BAG is filled with sea water and the cake dropped in.



▼ IT IS THEN kneaded gently for an hour to grind up the cake.



➤ DESALTED WATER is drawn off from a filter in the bottom of the bag.

odour has been described in the breath. Within an hour or two, delirium sets in, quiet at first but later violent and unrestrained; consciousness is gradually lost; the color of the face changes and froth appears at the corners of the lips. Death may take place quietly; more often it is a noisy termination, and not infrequently the victim goes over the side in his delirium and is lost."

Those who advocate the drinking of sea water argue that the effects so graphically described by Critchley do not follow when sea water is drunk by a man in water balance. They point out, moreover, that anyone who goes swimming in the sea swallows some sea water and that many castaways swallow substantial amounts of sea water before reaching the safety of a lifeboat or raft. The advocates of sea water maintain that by drinking small quantities of it immediately, a man can both slake his thirst and keep his body in water balance.

The question of whether or not a man can stop or avoid the sensation of thirst by drinking sea water is difficult to prove or disprove. In several experiments on drinking small quantities of sea water, the subjects have reported that they had no feeling of thirst. All these experiments took place in cool

AMNH photos



climates, and none of them ran for more than six days. In actual survival incidents under similar environmental conditions, survivors who had no water denied any feelings of thirst, and some who drank small amounts of sea water were thirsty.

Actually thirst is only a signal of the body's need for water. Thirst is often satisfied while the body is still slightly dehydrated. This is especially true in cool climates. Tests made by the U. S. Army in cold climates show that if men drink only when they are thirsty, they stay in a continuously dehydrated state.

The sensation of thirst varies a great deal with individuals. A person's description of how he feels changes with his psychological as well as his physiological condition, so the term "thirst" can be regarded as little more than an expression of personal opinion. However, the effect of drinking sea water on the body's water balance can be computed and the computations verified by experiment. It is possible to determine by actual test how much sea water the body can tolerate, though for obvious reasons laboratory experiments cannot carry the study to a point where the subject's life is actually endangered.

A vital function of the water in our bodies is to permit the kidneys to extract waste products from the blood in the form of urine. The chemical and physical processes involved in this function would take us beyond the scope of a general article. So we are centering our attention on the effect of the ingestion of the dissolved salts in sea water, predominantly sodium chloride or common salt. And the basic point is that the body uses only a very small amount of salt. Additional salt ingested must be excreted with the urine, using water which could be utilized by the body in other functions.

With the osmotic concentration of sea water only slightly below that of urine, the daily pint of sea water that the body will tolerate

will only yield about 3/10 of a pint (143 c.c.) of free water for the excretion of other urinary constituents, as Dr. Homer W. Smith points out in his book *From Fish to Philosopher*. The amount of water actually needed for urine formation is about a pint, not to mention upward of 1500 c.c. more (over 3 pints) for sweat, if the individual is exposed to sun and wind. Yet 500 c.c., or about 1 pint, is the greatest amount of sea water that can be swallowed each day without gastrointestinal disturbance from the unabsorbable magnesium and sulphate. Consuming larger amounts, concludes Dr. Smith, would only lead to diarrhea and further dehydration and would hasten the end.

The most favorable report on the

Three Canadians (below right) were able to cross the Atlantic on a raft (below left) because rain water was available.

London Daily News



use of sea water is that of W. S. S. Ladell, printed in *The Lancet*, October 9, 1943. Ladell ran a series of experiments with a group of seventeen men on a "shipwreck ration" such as was carried in life-boats. Some of the subjects drank sea water, others fresh water or fresh water plus sea water.

Ladell summarized the effects of drinking up to 400 c.c. (a little less than a pint) of sea water daily. The subjects were either totally or partially deprived of fresh water and were on the low-calorie and low-salt diet of the "man on the raft." Thus they were getting almost all the salt their bodies used from the sea water they drank. Ladell's conclusions were as follows, both for men drinking only sea water and for those using sea water as an "extender" for an inadequate fresh-water ration:

(a) At first, the subject retains the same amount of chloride that his body had lost before he began to drink sea water. Subsequently he excretes the full amount of chloride taken in. (b) The output of urine is increased, but there is a slight gain in the amount of the water in the body, because the extra water lost in the urine is less than the extra water taken in as sea water. (c) There is a gain in the total urea clearance.

(It should be noted that this experiment was performed in a laboratory where sweating would be at a minimum.)

Ladell's experiment indicated that a *slight advantage* was to be gained when a man on limited fresh water or without any fresh water drank *small quantities* of sea water. However, the agency sponsoring the research did not recommend the drinking of sea water. Evidently it was felt that the small gain to be expected did not warrant the risk involved. Even if the survivor was able to hold his intake of sea water down to the limit recommended by Ladell (400 c.c., or less than 1 pint), the small volume of water gained in this way could not support human life indefinitely and would give little if

continued on page 555

THE WONDER

We take for granted the substance on which all life depends, not realizing that it has more strange properties than any other common fluid

WATER plays a role on this earth surpassing in importance that of any known substance. It is even more essential to life than air; at least it must be present first. Were a seed completely dry, it would never germinate when you plant it. Locked within the dry impervious shell, every seed contains some water. The germ of all life exists only in the presence of water.

The cell is the unit building block of all plant and animal life. Its protoplasm may contain from 60 to 90 per cent water. This unit, on which all life depends, contains suspensions or solutions of countless substances in water. In fact, the majority of living things on this earth actually live in water—the ocean.

More than 70% of the earth is covered by water. Fortunately for life on earth, water is not static but constantly on the move. After a rainfall, some water percolates into the ground, some runs off by way of streams to the oceans, some evaporates, and some is given back to the atmosphere by the transpiration of plant life and the breathing of animals.

Tremendous amounts of water are present in living organisms. Your blood plasma is about 90% water, and your body as a whole

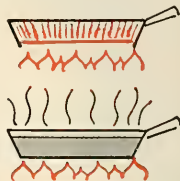
contains 75% or more water. Of course, much of the water is in chemical combination with other substances. Water is so important to your chemical make-up that a 20% loss of water from your body would cause death.

If you have a friend who declares that he never drinks water, he obtains it, of course, in the food he eats. A good steak may contain more than 60% water, and potatoes



78%. Some vegetables contain even more. Your body itself *forms water* as a bi-product of chemical oxidations—as much as two cupsful each day.

Water is unique in many of its properties, nearly all of which in some way affect life. For example, the fact that cells of living matter contain a high percentage of water means that cells can absorb more heat with less rise in temperature than any other common substance. This property is called specific heat. Water has the highest specific heat of any common substance much higher than the earth or the materials of which it is composed. The aluminum pan on your stove heats up quickly, but if it contains



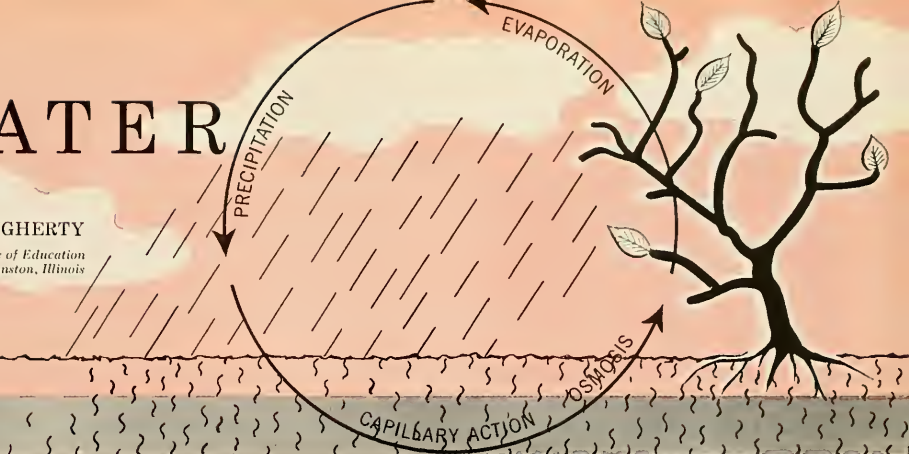
ABOUT THE AUTHOR:

Pennsylvania born, Prof. John H. Daugherty has studied at four institutions and taught at seven. He served as a technician at the Radiation Counter Laboratory in 1952 and 1953 and is now Chairman of the Department of Science at The National College of Education at Evanston, Ill.—Ed.

OF WATER

By JOHN DAUGHERTY

National College of Education
Evanston, Illinois



even a small quantity of water it heats up very slowly. It takes almost five times as much heat to raise one pound of water one degree as it does a like amount of aluminum. Thus the high specific heat of water aids cells in maintaining reasonable temperatures.

When living matter does overheat, another characteristic of water comes to your aid. Evaporation is a cooling process, and water again is unique—it requires more heat to change water to a vapor than any other ordinary liquid—in some cases ten times as much.

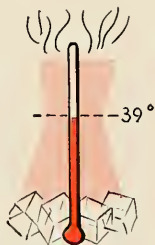


On hot days you perspire, and the heat to evaporate the perspiration comes from your body, thus cooling you off. Were your sweat glands not functioning, as in a recently reported medical case, you would need to take frequent ice baths during warm weather or live in air-conditioned surroundings.

Some liquids may exceed the dissolving power of water in certain instances, but no other liquid can dissolve such a wide variety of

things and in such quantities. Only dissolved substances can pass through cell walls in your body. The process by which they travel through membranes is called osmosis. It takes place when solutions of unequal strength are separated by a semi-permeable membrane like a cell wall. Cells can receive food nutrient and get rid of waste products in this manner.

One property of water proves to be an exception to the general rule of how substances react to heat. Most substances expand when heated and contract when cooled. As water is cooled toward the freezing point, it contracts until it reaches a temperature of about 39 degrees Fahrenheit, but from this



point downward to 32 degrees, the freezing point, it *expands*! This means that the coldest water, which is less dense because it has expanded, stays on top and is the first to freeze. The ice stays on top, too, because it is less dense than water. As a result, it is there to be melted first when the weather warms up.

Life can still go on under the ice with the aid of oxygen dissolved in the water.

While gravity pulls all things toward the earth, water can nevertheless rise from considerable depths in the soil by capillary action. Capillary attraction is the force that causes a liquid to rise in a very small tube. Water not infrequently rises four feet or more through fine pores in the soil. If you place the corner of a cube of sugar in your coffee, soon the whole cube is saturated by capillary attraction. One of the most recent fountain pens to be designed uses the principle of capillarity to fill it. Plants depend upon this action to obtain water during dry periods. The sap of a tree, a water solution, rises to the top of the highest tree with the help of capillary action, osmosis, and surface tension. Some details of the complex process are still partly a mystery.

This last characteristic of water, a high surface tension, aids some insects, too. The molecules of the top layer of a water surface seem to be stretched like a membrane. It takes but a small force to break the film, but some insects, such as the water strider, can skim across it without getting their feet wet.

Water, with its many unique properties, is inseparable from your life, and its manifold uses in science and industry are of primary importance to our comfort and happiness.

Nature's *Moth* Killer

The *Ophion ichneumon* fly operates its own fifth column. It shoots its eggs deep within the *Polyphemus* moth's larvae, and the grub that emerges eats its host alive!

By HAROLD V. GREEN

Photographs by the author



▲ THE FEMALE *POLYPHEMUS* MOTH is capable of laying 300 eggs. The larvae are voracious leaf-eaters. Where abundant, they constitute a serious threat to our shade trees.



▲ FORTUNATELY THE ICHNEUMON FLY (also known as the Ophion wasp) keeps the situation under control. It seeks out the larvae of these large moths and lays its eggs deep within them. The ichneumon's grub then eats its way out.

THE Polyphemus moth is capable of laying 300 or more eggs. The leaf-eating larvae that emerge from these eggs could wreak havoc among our shade trees. Fortunately for us, they do not become too numerous, for the Ophion ichneumon fly has as its goal in life the destruction of the caterpillars of these giant moths.

When the Ophion ichneumon fly, also known as the Ophion wasp, finds a Polyphemus caterpillar, it alights close to the caterpillar with its antennae nervously twiddling and prepares for the attack. As though realizing the Ophion's intentions, the caterpillar will often jerk its foreparts high into the air, pull back its head until it appears hooded, and make a clicking sound with its jaws. I have known grown men when menaced in this fashion

to draw back in real alarm. However, this "terrifying attitude," as it has been called, does not disturb the Ophion in the least. It advances upon the caterpillar from the rear, plunges its ovipositor like a hypodermic needle into the caterpillar's body, deposits one egg, and then makes off. All is again as it was: the caterpillar appears and acts unharmed. But deep within its body lies a tiny, deadly seed.

As a rule, shortly after receiving an "injection," the caterpillar begins spinning its cocoon. This is not brought on by the injection. The Ophion, in some mysterious fashion, seems to recognize and single out caterpillars that are about to pupate, and it reserves its seeds of death for them alone.

The Ophion's egg hatches within the caterpillar's body, and the grub

that emerges begins at once to eat its host alive! By the time the Polyphemus caterpillar has spun its cocoon, the grub of the Ophion is full-grown. The caterpillar, having used every last bit of energy in spinning its cocoon, gives up the struggle for survival and dies. Its silken sheath, which was to have cradled it until time for its rebirth in a lovelier guise, becomes instead its shroud.

Now the parasitic grub of the Ophion, made fat by its meal of the caterpillar, pushes the drained husk of its host to the bottom of the cocoon and spins itself a dense, brownish-colored envelope within that spun by the caterpillar. It then pupates. Later, in the spring, instead of a large moth, a giant relative of the wasp family emerges—the Ophion ichneumon fly.



▲ WHEN FREE OF ITS HOST, the ichneumon grub spins its own cocoon inside the cocoon of the *Polyphemus* larva. At this stage of its development, it is full-grown and about to enter its pupal state to be metamorphosed into an adult ichneumon fly.



▲ AFTER THE ICHNEUMON FLY has cut a "trap door" in its own cocoon, it has to make an opening in the moth's cocoon.



▲ THE ADULT ICHNEUMON FLY has just emerged from the moth's cocoon.

➤ AN ICHNEUMON FLY'S COCOON which has been removed from that of its host—the *Polyphemus* moth. At the right is shown the neatly-cut "trap door" made by the emerging adult ichneumon fly. The lumpy mass on the left end of the cocoon is the drained, deflated husk of the *Polyphemus* larva.



The Hamster changes to Winter Oil

In the secrets of the hibernating animal may lie greater safety for the patient undergoing heart and brain surgery

By PAUL O. CHATFIELD



Albert F. Marsh

If you keep a golden hamster at an environmental temperature of about 41 degrees F., a remarkable change will take place in its body. This low temperature causes the animal to prepare for hibernation, during which its temperature will fall to a level very close to that of the surrounding air. At such low temperatures, the hamster's fat



◀ THE GOLDEN HAMSTER during its waking state is an alert little animal, ever curious about its surroundings.

would become "frozen"—too hard for utilization as nourishment during its long sleep. But this is no problem, because the hamster automatically "changes to winter oil." Its fat is transformed to a less saturated form, so that as the animal's temperature drops, it remains liquid, usable as a source of energy.

The hamster finally curls up into a ball, and its heartbeat slows down to perhaps only four beats a minute, instead of a usual rate of about 400! It breathes perhaps once every two minutes, and its metabolic rate, as reflected by its oxygen consumption, drops to 1/30 of what it was in the normal state. The animal may remain in this lethargic state for weeks, or it may awaken in a few days.

The process of waking from hibernation is also dramatic. When the animal is mechanically disturbed, or at some unknown signal, it begins to tense its muscles, thus increasing the production of body heat and the consumption of oxygen. It starts to breathe faster, and the heart rate increases gradually. Its blood pressure also rises. When the body temperature reaches about 68 degrees F., the "brain waves," which were absent during hibernation, return. After about three

hours, the hamster is fully awake, scurrying about and acting as if it were greatly enraged at being rudely awakened.

The hibernation of the golden hamster, and of other animals, is

➤ DURING HIBERNATION it is curled up into an immobile ball. The only visible sign of life may be an occasional respiration.



now of interest even to surgeons. They have discovered that chilling the body of a patient is useful during operations on the heart and brain, and they have turned to hibernating animals to study ways of increasing the safety of their "hypothermia," or temperature-lowering techniques. What is being learned of the life processes of such animals as the golden hamster may therefore prevent disaster to humans during these critical operations.

♦♦♦ A Woman Saved by Hibernation ♦♦♦

An expectant mother who remained unconscious for over 24 weeks after suffering brain injuries, was kept for a week in a "virtual state of hibernation." Her temperature at the time of her admission to a London hospital was rising to a dangerous level. By means of cooling anesthesia, it was reduced to as low as 12.6 degrees below normal, and the most critical period was passed. Her baby, a son, was born November 8.

(From The New York Times.)



▼ THE HILLS PEOPLE of Nepal use the Pangolin's scales for rings and necklaces, which are worn to ward off rheumatic diseases.

A Study in Scales

The strange-looking Pangolin comes equipped with its own protective armor — a coat of hard brownish-gray scales!

By SAMIR SEN

Photographs by the author

NOT so long ago I was aroused one morning by the news that a nomad had crossed the mountains from Nepal bringing a "weird creature" with him. Would I identify it?

Dressing hastily, I went out to find myself confronting what looked like a relic of some prehistoric age. Its entire body was covered by protective armor—brownish-gray scales that overlapped one another in a most systematic and attractive pattern. Turned over, its underside proved to be tender and flesh colored, like the palm of the human hand. Its overall length, I afterwards ascertained, was twenty-eight and one-half inches.

As I collect and keep a number of "wild" animals from the Himalaya, I was thrilled to have before me a young, male *Salak*—the local, Indian name for the elusive creature more universally known as the pangolin.

The pangolin (also called the

scaly anteater) is the Old World counterpart of the armadillo and anteater of the American hemisphere. Several species of pangolins, grouped into one genus, have been found to exist in the moist equatorial forests of the Old World. Two distinct species are found in India. The Indian pangolin (*Manis crassicaudata*) inhabits the plains and lower slopes south of the Himalaya. The Chinese pangolin (*Manis pentadactyla*), also called the eared or hill pangolin, is found at moderate heights in the Himalaya. The specimen brought to me

belonged to the latter species, the Chinese pangolin.

After sharing my knowledge of the "creature" with its owner, I asked the old man what he intended doing with it. To my horror I learned that he was waiting for it to die so that he could make "big medicine" to use on himself.

This practice is common among remote Himalayan tribes, so I was not unduly surprised. Various parts of rare animals and birds are concocted into potions reputed to cure every conceivable human ailment. Several months previously a burly Tibetan trader had implored me to give him a claw from my tame leopard. (The claw of a living leopard is supposed to possess *very great* charm against disease.)

I have found that there is little to be gained from trying to dissuade natives from these age-old beliefs. But I was determined to rescue the pangolin from the ignominious end that seemed to await it, so I asked the old man

Owner of a large estate in India, the author is a keen collector of wild animals and birds. A schoolteacher, he also lectures on natural history. His ardent love of nature and wild life goes back for three generations.



what ailed him. A prolonged dis- course on the subject indicated a case of malnutrition, coupled with old age. A fair sum of money and an impressive bottle of brightly-colored tonic sent the old man happily trudging off to the local wine shop, and I became the proud possessor of a very fine pangolin.

I was now free to examine the new member of my "wild" family and to ascertain all that I had read about it. Sure enough, the hard scales were, in fact, composed of agglutinated hairs that covered the upper part of the head, the back and sides, the whole tail, and the outside of the limbs. A few bristle-like hairs grew on its underside and between the scales. I found that there were 18 rows of scales around the body, 10 rows of smaller scales on the top of the head, and 22 along the tail. Almost half of its 28½-inch length was body.

In its natural state the pangolin lives on ants and termites, which fall easy prey to its long, glutinous tongue. This tongue is worm-like and tapers to a fine point; its owner can comfortably extend it to a distance of 8 inches. I also learned that pangolins enjoy liquid food; at least mine does. In a matter of seconds, it will empty a bowl of milk or water with lightning flashes of its long tongue.

During the next several months I learned much more about the pangolin. Its "hands" consist of three long curved claws flanked by

a shorter one, and are ideally suited for burrowing. The animal can disappear into the ground with amazing speed. When walking, the claws of the forefeet bend inwards to form hard soles. But the whole soles of the hind feet, which possess shorter claws, are applied to the ground.

It possesses small eyes and ridge-like external ears, but its sight and hearing are poor. It makes up for this by its keen sense of smell. In a remote corner of my garden an abundance of insects is usually to be found. Sooner or later my pangolin will find its way to this spot, no matter where he may be placed at the outset.

Nothing stops him

The pangolin moves slowly with a swinging gait, sniffing the ground as it goes resolutely over, around, or under obstacles in its path. Being close to the ground it will often stop and stand up on its hind feet for a better look at the lay of the land before continuing its journey. It can do better than that: my Chinese pangolin can climb a tree with remarkable facility, although this species is considered chiefly to be terrestrial and sub-terrestrial. Grasping the branches firmly with its forefeet and prehensile tail, it is quite at home and difficult to dislodge. In Africa, I understand, a tree-dwelling species lives on ants and termites found on trees.

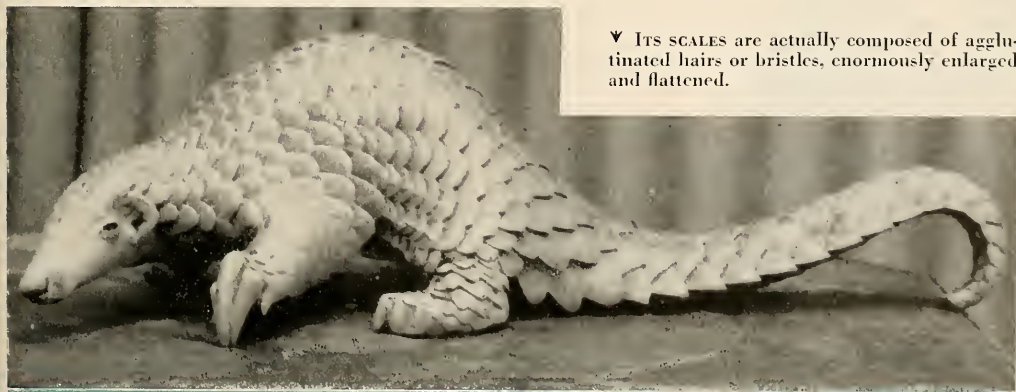
The pangolin seldom seems to

take the offensive. On one occasion I did see it grasp the leg of an aggravating kitten and hold it for a moment in a viselike grip. Then, without further ado—as if it didn't know what else to do—it slowly released it. Sitting up on its tail like a kangaroo, with its forefeet clasped together, it almost looked as if it were praying for a good set of teeth. When excited, the animal emits a loud hiss. I have not heard it make any other sound.

When asleep, or attacked, the pangolin curls itself into a tight ball. In fact it gets its name from this act, which is known in Malayan as "pengolin." The head is curled between the fore limbs and the tail firmly covers the head and the soft parts of the body. In this posture, it is completely protected by its scaly armor and displays prodigious strength when one tries to unravel it. The sharp protecting edges of the overlapping scales then serve for offense as well as defense.

These scaly creatures are more common in this part of the world than is generally supposed, but being nocturnal animals, they are not often encountered. Hiding by day in rock-crevices or in deep burrows that they have made themselves, they emerge only to feed at night.

I have derived much pleasure and satisfaction from observing my pangolin. I only hope my nomadic friend has enjoyed his tonic half as much!



▼ ITS SCALES are actually composed of agglutinated hairs or bristles, enormously enlarged and flattened.



Is there Life on other Worlds?

New advances in astronomy and other fields of science increase the likelihood that the complex conditions necessary for the creation of life have occurred in many other parts of the universe

ARE there men on other celestial bodies? Is *Homo sapiens* actually as remarkable a creature as he appears from the perspective of an insignificant planet revolving about a minor sun? What place does our puny world and its two-legged inhabitants occupy in the cosmic pattern?

Questions like these are not limited to readers of comic books and viewers of science-fiction TV programs. They are being asked—and sometimes answered—by sober scientists who command a world audience.

The subject is not only affecting intellectual but spiritual life, as evinced by a statement made by Father Francis J. Connell, Dean of the School of Sacred Theology, Catholic University: "It is well for Catholics to know that the principles of their faith are reconcilable with even the most astounding possibilities regarding life on other planets." Father Connell had no new information concerning "space men." He was simply ahead of most religious leaders in grappling with the theological implications of an idea that has burst into great prominence in our times.

By GARY WEBSTER

Typical of the serious scientific studies is a recent volume by H. Spencer Jones, Astronomer Royal of Britain. Significantly, he calls his book *Life on Other Worlds*. Interest runs so high that the volume has been issued in a soft-cover edition for mass distribution, and it was recently discussed in *Reader's Digest*.

Speculation on the theme is far from new. A few early Greek thinkers were of the opinion that the stars are inhabited. Hardly any sensible person accepted such a notion in ancient times, however. Was it not obvious that this solid Earth is central in the scheme of things?

Centuries later, Copernicus, Galileo, and their followers thought of themselves as pioneers in the new astronomy. But they were much more than that. Their discoveries affected major areas of philosophy. Earth was relegated to an obscure role in a boundless star-filled universe. Man's once-secure central place was challenged. Old ideas concerning his status were shaken: they rocked violently, then fell and shattered.

Echoes of the crash are still rumbling. Four centuries of intensive investigation have produced no final answers to some of the questions raised by modern conceptions of the physical universe.

Eager guesses have been offered in abundance, however. In 1601, Nicholas Hill solemnly announced his conviction that the sun and stars swarm with living creatures. That sounds absurd in the light of present-day knowledge of solar temperatures. But until recent generations, even astronomers had only a fraction of the data now available to general readers. With no facts to disprove them, many vague theories flourished.

In an atmosphere of such eager optimism, it was comparatively easy for Richard Locke to perpetrate a monumental hoax. He wrote a series of vivid articles, complete

with scientific terminology and descriptive details, purporting to describe "lunar men" seen through a huge new telescope. These stories were published in the *New York Sun* in 1835. Millions took them as sober fact. Religious enthusiasts even began collecting funds with which to send missionaries to the Moon.

Though the fraud was quickly exposed, it did not curb interest in the possibility of genuine discoveries. Improved apparatus showed the Moon to have little or no atmosphere, so attention shifted to Mars—the planet thought most likely to have conditions approximately like Earth's.

Percival Lowell, among the most distinguished of American astronomers, became convinced that the red planet supports life. His views were largely influenced by narrow streaks that he dimly perceived on the surface of Mars. After years of study, he concluded these to be canals built by intelligent beings who were making a gallant attempt to preserve civilization on the arid sphere.

Lowell's theories are now generally discredited. But the quest continues with undiminished zeal. Just as growing information about the Moon led men of the last century to shift their hopes to more distant Mars, so an increase of knowledge about that planet has resulted in a shift of attention to sections of the universe that are beyond observation.

So long as our solar system was considered to be the product of a celestial collision, planets were thought extremely rare. New "explosion" concepts of planet formation assume that many stars have families of encircling satellites.

Evidence provided by giant telescopes suggests that there may be some 100 million billion stars in visible galaxies. In no case is it possible to see their planets. But if the typical life history of a star involves the loss of fragments, there

may be myriads of unseen planets. Assuming them to exist, it seems reasonable that a small percentage have physical conditions similar to those that prevail on Earth. And where there are myriads, a small percentage may mean quite a lot. Therefore, life must exist on many spheres...

So runs the typical argument.

Present theories make it statistically likely that *Homo sapiens* is not alone in the cosmos. However, of direct evidence that "men" live anywhere other than upon Earth's crust, we possess not one shred.

Before accepting a probability estimate as "proof," it may be profitable to take additional factors into account. How did life itself originate? Through what influences did the manifold forms we know evolve? What are the minimum conditions under which such forms can continue to exist?

With all its tenacity, life is fragile. Because a high degree of organization is involved, environmental factors must be relatively constant. If any of a score of conditions were altered considerably, the human race would perish.

Temperature is among the most obvious of the factors bearing upon the life process. Heat tends to affect molecular structures in direct ratio to their complexity. Molecules that serve as building blocks in living cells are enormously more elaborate than those of most inorganic compounds. Hence, high temperatures destroy every form of life. Though low temperatures do not so certainly lead to death, metabolism and reproduction are geared to moderate ranges.

Earth's most extreme annual variations never exceed 250 degrees F.—and that figure is not reached at any one spot. True, temperatures as high as 133 and 136 degrees F. have been reported from desert regions in North Africa. And at the other end of the scale, the mercury has been known to plunge below minus 100 in Siberia. But most

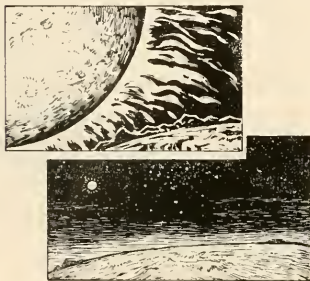
land surfaces are only about 100 degrees warmer in midsummer than in dead of winter. Oceans and tropical lands do not vary nearly so widely.

Cosmic temperatures range from the frozen death of absolute zero to hellish fury at the surface of stars—differences so great that no instrument can measure them accurately.

Our nearest celestial neighbor, the Moon, might be thought likely to enjoy a climate similar to that of Earth. But proximity is a false clue. Lacking the regulating effect of our planet's atmosphere and oceans, the surface of a satellite like the moon alternately sears and freezes. During an eclipse, the moon's temperature has been observed to fall from about 160 degrees above to 110 degrees below zero in a single hour.

No other body known to astronomy, except possibly Venus, even approaches Earth's efficiency in maintaining a global temperature that keeps water constantly liquid. Weirdly, however, that same narrow band is of maximum efficiency in organic chemistry. The temperature conditions on our planet give carbon compounds the instability that fosters change—without producing molecular chaos.

Water is the most important of solvents. Global temperatures constantly below freezing or above the boiling point would eliminate the possibility of life.



In order to enjoy the special range of climatic change that permits survival, a planet must be neither too close to its sun nor too far away. There must be an insulating blanket of air that is neither too thin nor too thick. The planet must rotate upon its axis at such a rate that days do not become too hot nor nights too cold.

Many other factors are involved. Their relationships are so complex that life-sustaining climates are rare almost beyond possibility of computation.

Even given a favorable heat band, there are fantastic odds

against a planet's having all other essentials for life. Water is one of them, for it is the chief component of both plant and animal cells.

Oxygen is needed by animals; most plants require a constant supply of carbon dioxide. On Earth, these problems are neatly dovetailed: photosynthesis uses carbon dioxide as a raw material, releases oxygen as a waste product. Meanwhile, animal metabolism burns oxygen and throws supplies of carbon dioxide back into the atmospheric bank. Strip vegetation from the planet, and the broken cycle would cause man to suffocate—assuming that he could ward off starvation.

Air is essential for life-sustaining gases, but it also serves as a shield against death-dealing radiation. Its ozone, water molecules, and layers of ions block or alter ultraviolet light and other emanations that rain upon our globe. No other heavenly body has yet been discovered to have anything even roughly comparable to our atmosphere.

At the Moon's surface, air is nonexistent or so thin that it cannot be detected. Failure has dogged every attempt to discover oxygen in the atmosphere of Mars, and astronomers agree that the red planet has only negligible traces of water vapor. Jupiter and Saturn are thought to be surrounded by clouds of ammonia and methane. Venus seems blanketed in gases unsatisfactory for the support of life. The planet Mercury is thought to be almost or entirely without air. Uranus and Neptune are known to be swathed in methane. Pluto, revolving in the celestial deep-freeze at the remote outer edge of our system, shows no signs of possessing anything resembling Earth's mantle of air.

Our planet's crust contains high concentrations of silicon, iron, and other comparatively heavy substances. Light gases are rare. Study of luminous bodies such as the sun and stars indicates that they are largely composed of hydrogen and helium—with only traces of ele-

When Harlow Shapley, the celebrated astronomer of Harvard University, was asked whether the likelihood of life on other heavenly bodies appears to be increasing, he replied:



Our expanding knowledge has been very important in reinforcing our belief that sentient beings are not uncommon throughout the universe.

We now know that some billions of years ago, stars and galaxies were crowded together. The origin of planetary systems would then have been highly frequent, although now essentially impossible, if collision is the source.

We also know that the stars, radiating life-supporting fuel, are to be counted by the sextillions, thus enhancing the probability of high sentient life.

Finally, evidence has accrued that the step from the inanimate to the animate by way of the amino acids is not impossible. In fact, life is probably the inevitable consequence of chemical evolution wherever physics, chemistry, and climatology are right.

ments that loom large in Earth's shell.

The chemistry of the human body is known to utilize at least fifteen elements: hydrogen, oxygen, carbon, iodine, sodium, nitrogen, sulphur, phosphorus, manganese, copper, calcium, iron, magnesium, potassium, chlorine. Lacking any one of these in usable form, life would be greatly modified if not quickly eliminated. Vegetable organisms—which produce all Earth's oxygen and food—rely upon oxygen, carbon, hydrogen, and nitrogen, with traces of other essential elements.

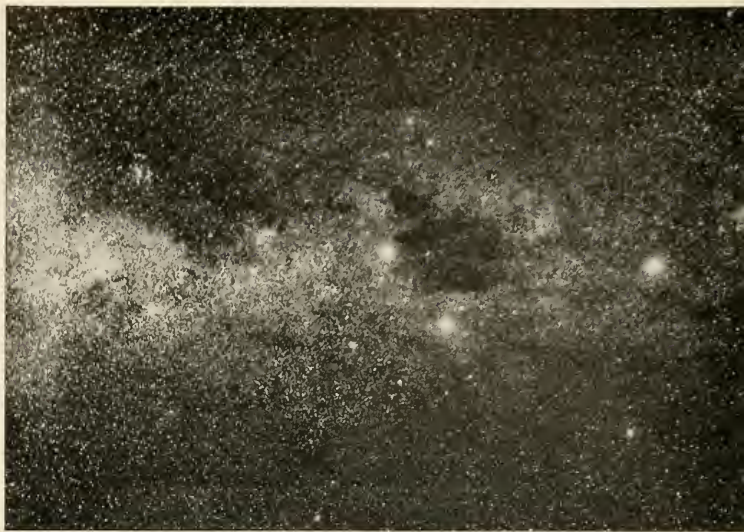
Given a planet with suitable temperature range, adequate water, precisely-balanced atmosphere, and a supply of essential elements, would not survival of its organisms be guaranteed?

Not quite.

Distribution of solids and liquids must be just right. If Earth were a perfect sphere, rather than a scarred and wrinkled spheroid, water would cover the entire surface of the planet evenly. Most geologists affirm that the continents actually float upon molten rock—somewhat as icebergs project slightly above the water but with all the hot rock underneath. A downward shift of less than three per cent in the granite-based segments of the planet's crust would sink every acre of land beneath unbroken oceans.

Only the precise ingredients—each in just the right amount and the whole molded neither too smooth nor too rough—can produce a planet boasting both seas and dry land. A modification of the proportions could reduce Earth to an arid desert or a sodden hulk eternally washed by huge globe-circling tides.

Viewed thus, it may seem incredible that even one heavenly body should provide an environment in which life can be maintained. But difficulties in accounting for the preservation of Earth's organisms are trifling when compared with enigmas that shroud the origin of life itself.



Harvard College Observatory

▲ THE MILKY WAY contains the equivalent of approximately 100 billion suns. Its diameter is estimated to be about 100,000 light years.

No one has yet offered a satisfactory description of the phenomenon called life. We know that the same chemical elements and physical forces are involved in both living and nonliving aggregations of matter. But it helps very little to agree that the living state is marked by unique electro-chemical relationships—for we do not know what those relationships are. "When we speak of Life itself," said D'Arcy W. Thompson, "we know that we speak of a great mystery. We seem to have stepped unbidden upon holy ground."

Thompson was neither a mystic nor a visionary but a hard-minded scientist with an international reputation, who simply made articulate what many have recognized.

At breakfast, you and I can share a piece of toast or divide a waffle in half. It is a major enigma that food is so transformed in digestion and metabolism that part of it enters *your* life structure and part is incorporated within the organism that is *me*.

This much is clear: life must utilize non-life in order to extend the duration of its own intricately-balanced state. Yet all the evidence

points to the conclusion that only a living organism can beget new life. We are left with a neat riddle upon our hands: how did life originate?

There are three classical solutions; none has won anything like universal acceptance.

Religious seers urge that life was launched through a special creative act on the part of a divine being. Ancient scientists—and many modern ones—have thought that living organisms arose spontaneously through the interaction of natural forces. A few noted analysts have urged that "life" is a special ingredient of the cosmos, no more created or originated than matter and energy.

Proponents of the third theory hold that sperms or spores have always been scattered throughout the universe. Whenever they fall into a suitable environment, they multiply. Thus, life did not originate—because there never was a time when it did not exist. Earth owes her vast panorama of organisms to the fact that particles of this eternal "life substance" happened to reach the planet at an appropriate stage in its develop-

ment. No less a thinker than Lord Kelvin supported this view. According to him, life reached Earth as a passenger upon a chance meteorite.



Careful laboratory study of numerous fragments from space has failed to reveal the presence of cosmic hitchhikers. There is no experimental evidence to support this theory of "panspermia."

Precisely the same can be said of the view that is most popular with contemporary scientists. Many authorities are rather confident in saying that life must have arisen spontaneously from not-life. There is of course indignant repudiation of such notions as Van Helmont's, who as late as the sixteenth century thought he succeeded in bringing about spontaneous generation of mice from a paste of damp flour and soot!

Contemporary views are much more refined than Van Helmont's. Natural forces, say many thinkers, caused gradual establishment of more and more complex molecules. Carbon formed the skeleton of many. Eventually, chance combinations produced molecular field conditions of such nature that the giant carbon-fouled cluster began to perpetuate itself. This took place in the warm shallows of a primeval sea whose waters contained all requisite materials in solution or suspension. Once launched in this fashion, life has been shaped and modified by environmental influences. From this primitive beginning, ages of natural processes have produced every living creature on Earth.

Some ask: "Why, if life once began spontaneously, is the process not continually being repeated? We should see new forms arising all the time in swamps, lagoons, and inlets." One fairly obvious answer would be that man has only been in a position to watch for such

events for a "split second" as geologic time is measured. But the specialist may point out that there was apparently no free oxygen in the earth's early atmosphere and that when it came, the origin and persistence of primitive organisms became an accomplished fact. That is as much as biochemistry can yet tell us.

That is where the matter rests. It is impossible to prove the validity of any view. Divine creation, cosmic sperms, spontaneous generation—each rests upon belief rather than observation.

Lacking experimental evidence to support any view, the scientist is forced to admit with D'Arcy Thompson that life's origin is at present an insoluble riddle. The existence of living organisms upon our tiny planet neither weakens nor supports the idea that other heavenly bodies have civilizations of their own.

Somewhat more satisfactory evidence is available in relation to our final question: Through what influences did life assume its manifold forms?

Without understanding how life was launched upon Earth, it is possible to indicate some conditions without which *Homo sapiens*, for example, could not have developed. Details are hopelessly obscure. There is an uncharted abyss between "first life" in the form of a one-cell organism and the 26 million million integrated cells of a human child at birth. Indeed, the radical break between not-life and life is hardly more inscrutable than steps in the progression from primitive amoeba to a creature possessing nerves and bones, specialized organs, sensory systems, and a brain that permits development of language, culture, religion, and science.

Many significant links in the chain of organic modification are obscure or completely unknown. A few of the factors—such as gravity—are sufficiently clear for crude analysis.

Jupiter, looming 317 times as massive as our planet, exerts a pull

so strong that human locomotion would be impossible on its surface. The effect of a strong gravitational field upon the shape of the brain, circulation of the blood, and structure of the skeleton is a matter for conjecture. Precise possibilities of organic evolution under such influences are unknown.

Nor is there any certainty as to what forms could develop in a gravitational field weaker than that of Earth. At the surface of Mars, the incessant tug is only 38 per cent as strong as upon our own planet. On other spheres, gravity varies from a negligible force to pressures great enough to liquefy hydrogen.

Given a planet identical with Earth in every respect but gravity, and varying significantly at this point, *Homo sapiens* could never develop.



Nearly everything about Earth appears exceptional. Even the Moon is a celestial oddity. No other body in the solar system is remotely comparable to it. There are satellites about other planets, of course. But most are comparatively tiny. Jupiter and Saturn, to be sure, have sizable satellites but not so large as the Moon in comparison to their own great size. Weight ratios between satellites and the planets they circle range from 1:4000 to 1:16,000,000. Weight ratio between Earth's bright daughter and the parent planet is 1:81.

The Moon may have been torn or ejected from the side of Earth. One theory is that this took place after our planet had cooled sufficiently to form a thin shell about its molten interior. It has been argued by some that the Pacific Ocean represents the remnant of the jagged hole that the Moon left. But this is only one of the hypotheses.

Down through the geologic ages, the earth has been subjected to

long-term climatic cycles, which have influenced the course of evolution. So also has the "accident" that gave our planet its annual progression of seasons. This is the result of its being tilted on its axis at about $23\frac{1}{2}$ degrees, as is shown by every schoolroom globe. If the axis were either parallel with or perpendicular to the plane of revolution about the sun, seasonal changes would vanish into the deathly monotony of unvarying years.

Still another temperature cycle is linked with rotation. Because the planet spins comparatively rapidly, there is quick and regular alternation of light and darkness, heat and cold. Mercury's rate of rotation is geared to its passage about the sun. Hence one side continually bakes, the other is perpetually frozen.

Benefiting as it does from at least three types of cyclical temperature change, Earth becomes a planet of struggle - within - endurable - limits, never plunging above or below levels for life. The biological significance of this phenomenon is beyond estimate. Lacking ordered change within an extremely narrow temperature range, the history of organic development would be quite different.

In order to harbor creatures broadly comparable to the ones we know, other planets must not only possess conditions to sustain life. They must have passed through a pattern of cosmic development reasonably similar to Earth's. It is not a set of isolated qualities that must be matched, but the whole of an infinitely complex pattern extending through vast periods of time. And without a basically similar biological heritage, no planet would have produced a man or anything approaching it.

Earth's possession of living forms even in the broad sense, therefore assumes new significance—not in spite of the new astronomy but because of it. That each detail of the incredible panorama should be exactly duplicated in sequence is statistically about as likely as



Lick Observatory

▲ THE NEBULA OF ANDROMEDA is a separate galaxy comparable in size to our Milky Way. It is estimated to lie $11\frac{1}{2}$ million light years away.

the proverbial re-creation of Shakespeare's entire works by a chimpanzee striking typewriter keys at random.

Even on the strangely sheltered planet that nurtures the only life we know to exist, there are perhaps ten million species—but only one *Homo sapiens*. Perhaps it is not too much to suggest that even in this special environment, it required an almost incomprehensible number of trials to produce a single strain of men.

Men of Earth think, talk, laugh, hope, experiment, compute, and manipulate symbols. Hence, until we know there are comparable creatures on other planets, we may consider man the central mystery of the cosmos.

Is he the product of accident . . . or the fruit of design? Did he develop as a result of purposeless forces which fitted him to live on the wandering sphere that is Earth . . . or was Earth created with infinite pains in order that it might be the cradle of man?

No one ventures to claim that man has been duplicated elsewhere, but we may ask whether scientific thought is not tending toward possibilities no less startling.

Harold C. Urey, atomic physicist at the University of Chicago, recently estimated that life exists on at least 100,000 planets. Less conservative analysts place the number of inhabited bodies at ten times that figure.

There are billions of heavenly bodies more or less like Earth. Each has billions of years in which to be affected by natural forces. "It would be at least strange," urges physicist George Gamow, "if life—even in its highest forms—had failed to develop in these 'inhabitable' worlds."

Our minds are being stretched beyond customary limits. Perhaps it will take electronic computers—products of man's brain but more capable of handling astronomic figures—to evaluate probabilities of other thinking creatures in the almost limitless realms of space.



Cinnamon

Spice that

Changed

History



Some of the most
hazardous
and adventurous
trade routes
in history were
pioneered in
the name of cinnamon

By ALICE L. WOOD

Dalchini? No, *Memsahib!* But try this!" The enterprising merchant pointed hopefully to a small brown heap of powder.

"No! No! It's cinnamon I want!"

Then a neighboring merchant, on his knee-high wooden platform, pulled out a stick of cinnamon three or four feet long, and we bargained as to its price. We reached an agreement, the *dhoti*-clad Indian and I. He sold me the cinnamon by the *tola*, weighing it out on tiny scales. Then he wrapped my long fragrant wand in an old copy of the *Hindustani Standard* and lounged back on his

heels, surrounded on all sides by trays full of his wares: small red piles of cayenne, orange-brown curry powder, and gnarled ginger-root. Here were seeds and bulbs and powders to baffle the eye of an uninitiated American.

We inched past sweetmeat stalls, droning with hungry flies; past Brahmin calves, nibbling the fresh produce; and past the red-toothed patrons of the betel-nut merchants. Ha! How our hungry G.I. chowhounds would love us dietitians for this cinnamon; for cinnamon (*Cinnamomum zeylanicum*), or actually cassia-bark

(*C. cassia*)^{*}, is America's second most-used spice, and C-rations certainly were dull in India!

This spice, *dalchini*, or *darchini*, as it is called in the East, has a name that means in Persian "Chinese wood," and it is believed to be the oldest of the spices. Only recently has it been relegated solely to kitchen uses, for once it was among the world's most precious commodities. Imagine wanting cinnamon and spices so much that you'd be willing to sail to the ends of the earth for them,

^{*}There are a dozen or more plants called "cassia" in English. Most of these are in the legume group and are not related to the cassia-bark tree of this article.



Bettmann Archive



DA GAMA'S VOYAGE, the first European journey by sea to India. It netted an estimated 6000 percent profit.

at a time when the world was thought to be flat and navigators feared that they might fall off the edges! Or, as if that weren't enough, there were tales of sea monsters, which terrified sailors perhaps even more than the very real dangers of scurvy. Then there were pirates and mutinies to add to the hazards, for crews of sailing ships were recruited largely from prisons. Nonetheless, Da Gama and other navigators risked all of these dangers to attain treasures like spices!

Cinnamon came to Europe during Greece's Golden Age. Later, Roman galleys brought it from Phoenician cities such as Tyre to the plutocrats of Rome, but from about the fourth century before Christ until the time of Da Gama, the Arabs controlled Europe's spice imports. The "Spices of Araby" came by camel caravan across Asia. During the early Renaissance, the merchants of Genoa and Venice bought spices from these Arabs and traded them all over Europe. The great fortunes from the spice and silk trade provided the wealth that built

Venice's architectural glories and endowed the sumptuous buildings where Michelangelo and his contemporaries painted their masterpieces.

But an American businessman would not have envied the Arab tradesman, with his caravan of acrid-smelling, ill-tempered camels. This tradesman faced many dangers on his trek through Asia. Nonetheless, profits were so high that he took measures to keep his monopoly secure. Cinnamon, the Arabs told curious Europeans, was found in the nests of strange birds—like the phoenix. The harvesters collected it when the birds carried heavy pieces of flesh to their nests, causing the cinnamon to fall out; or again the cinnamon hunters might shoot the birds with arrows loaded with lead. There was another story that cinnamon grew around marshes where frightful monsters guarded over it.

The Crusades spread the taste for spices throughout Europe. It was during the fourteenth and fifteenth centuries that cinnamon and spices began to come into their own on the banquet tables of

England. Meat courses, served in such profusion, were seasoned lavishly with the available condiments and spices, including cinnamon. But in that day, before the era of the fork or the dictum of Emily Post, cinnamon and spices were so scarce and expensive that only kings and noblemen and their cooks and official tasters could afford to eat them. Spices were not just tasty. They preserved food and helped to disguise the flavor when it spoiled.

But cinnamon had other functions of far more vital significance than its culinary role. The ancient Greeks placed boughs of cinnamon (or perhaps it was cassia-bark) in the temples of Apollo. Cinnamon was used in religious rituals of the Hindus and in those of most of the other religions of the Eastern Hemisphere as well. Cinnamon helped to make the sacred oils of the Tabernacle. When, in ancient Rome, the patricians—men as well as women—used cinnamon to scent their baths, they were severely censured for defiling the precious gift of the gods. During the Middle Ages, cinna-



"SPICES OF ARABY"

came by camel caravan across Asia.

mon was used as an ingredient of various charms and acts of black magic. The medieval lover, as part of the hocus-pocus he employed to win the admiration of his lady-love, bathed in cinnamon—and used it to concoct love philters. In India today, it is used in dyeing calico and as an ingredient of medicine.

Only gradually was the mystery of cinnamon's origin dispelled. Marco Polo, in his accounts of travels in the Orient, told of seeing it produced in India and Ceylon. Like many another skilled raconteur, Marco Polo's listeners accepted his adventurous accounts as less than 100 per cent truth. But finally his tales were confirmed when Vasco Da Gama (in 1497 and 1498) made his southerly voyage in search of a route to India.

Da Gama reached India with a fleet of four caravels—square-rigged, flat-bottomed vessels which were the finest ships afloat at that time. His crew was armed with swords, boarding pikes, spears, and crossbows, and few of them were armored. It was on May 21, 1498, that he landed in Calicut. The journals say:

"The captain-major sent one of the convicts to Calicut, and those with whom he went took him to two Moors from Tunis, who could speak Castilian and Genoese. The first greeting that he received was in these words: 'May the Devil take thee! What brought you



Brosen Brothers

▲ A SPICE SELLER of Iran, weighing his wares on a balance as merchants in Asia have been doing for many centuries.

hither?' . . . He told them that we came in search of Christians and of spices."

As he was leaving Calicut to return to Portugal, the Zamorin had him captured and thrown into prison. Later the Zamorin released him and sent a note written on a palm leaf to the King of Portugal:

"Vasco Da Gama, a gentleman of your household, came to my country, wheracat I was pleased. My country is rich in cinnamon, cloves, ginger, pepper and precious stones. That which I ask of you in exchange is gold, silver, corals, and scarlet cloth."

Da Gama returned to Portugal with a rich cargo, for the expedition made profits of 6000 per cent and is considered financially one of the most successful voyages of exploration in all of history. Da Gama went back to India twice—once to revenge himself with heartless cruelty for the imprison-

ment, and then to establish a colony for Portugal.

In 1505, Dom Lourenço de Almeida ran aground on Ceylon while hunting for rival Mohammedan spice ships. This began one of the bloodiest and most unsavory chapters in colonial history. First the Portuguese, next the Dutch, and finally the British exploited Ceylon for its spices. The Portuguese established a special caste to do the cinnamon-harvesting. The Dutch made a treaty with the multititled King of Kandy, "prince descended from the golden sun," "he before whom all elephants bow," to drive out the Portuguese. Then they proceeded to make themselves even more disliked, if possible. In their attempt to establish a cinnamon monopoly, the Dutch made it a crime to steal or tamper with cinnamon trees or their product and declared that all cinnamon trees, even if they grew on private property, belonged to the king of Holland. Offenders were punished by death, and since the Ceylonese were not inclined to co-operate,



ROMAN GALLEYS brought cinnamon to the patricians of Rome.

entire villages were slaughtered. To bolster the price of cinnamon, shiploads were sent to Holland to be burned. Since cinnamon and cassia-bark trees grew wild on the tropical islands thereabouts, as well as in eastern India, Burma, and western China, nature combined with the Ceylonese to defeat the enterprising Dutch.

The British took Ceylon in 1796 and put the cinnamon monopoly in the hands of the East India Company. Later, they taxed cinnamon exports at as much as half their value. This drove cinnamon off the world market, since the cassia-bark of French Indo-China and the Dutch East Indies was cheaper. Cassia-bark is still more popular in much of the world than is the milder Ceylonese cinnamon.

The East India Company was an outgrowth of the Grocer's Company of London, which is said to have taken its name from the fact that it sold foodstuffs like spices in generous quantities, like the gross. A royal charter allowed, and

later obligated, the Grocer's Company to "garble" (inspect and cleanse, or destroy) foodstuffs sold in the city of London. Anybody who sold "ungarbled" spices might be fined, imprisoned, or placed in the pillory. One culprit who was pilloried had an opportunity to savor his spices as they burned under his nose!

One inducement to effective food and drug legislation in America was the evidence of widespread adulteration of spices. In 1887, a study showed that half of the cinnamon and cassia-bark on the market was adulterated with things like peas, starch, mustard hulls, turmeric, minerals, cracker dust, burnt shells, and charcoal—unexotic additions to the once so cherished spice!

Today, both cinnamon and cassia-bark are sold in the United States as cinnamon, and what we think of as cinnamon is almost always cassia-bark. Cinnamon makes up only about fifteen per cent of the total import and is used mostly for garnished beverages—

swizzle sticks for mulled drinks. The Old Fashioned and a variety of punches can likewise take such a garnish, but for other uses Americans prefer the stronger-flavored cassia-bark. Most of the true cinnamon is marketed in Mexico, where a great deal of it is used to mix with chocolate.

For all of their ingenuity, American chemists have not yet succeeded in duplicating the flavors of spices, for the essential oils and known ingredients of spices comprise only part of the flavoring materials. Chemists think the resins, alkaloids, and glycosides, apparently combined with other unidentified chemical compounds, are what give a spice its characteristic flavor. Grinding tends to break down the cell walls and cause the spice to lose its odor and flavor more quickly than when whole. This is partly because the essential oils are volatile but also because the natural antioxidants, which were trapped in the intact cells, are now free to escape or be oxidized. The fibrous material in

American Spice Trade Ass.



▲ A NATIVE OF CEYLON standing next to a cinnamon bush. This is the true cinnamon, as distinct from cassia-bark.

➤ THE PLANT is cut back to produce numerous shoots. From between the inner and outer bark comes the thin layer called stick cinnamon.

Brown Brothers



the cell walls of cinnamon bark may in itself be important to flavor. Anyhow, freshly ground spices are noteworthy for their fragrance.

Spiced products improve with age. Science and technology today give the nod of approval to the age-old practice of making plum pudding and fruit cake well in advance of the holiday season. Some of the spiced vegetable drinks, too, ought to stand for four to five hours before they are served.

Modern studies have also borne out traditional beliefs in the value of spices as preservatives. The antioxidants seem to be responsible. With baked products like pastries, tests have shown that while salt hastens the development of rancidity, spices delay it.

The practical gourmet will want to make sure that the spices he uses are of the first quality. American spice manufacturers assure him that they are, if he buys them in small quantities (no more than a six months' supply at a time) and stores them in airtight containers. The American housewife, they add, can purchase a complete spice shelf for five dollars. This means that spices cost a small fraction of one per cent of

the consumer's food dollar—but how much they add to his enjoyment!

How his medieval ancestors would envy today's consumer! With spices guarded by a friendly neighborhood grocer, who supplies them clean, safe, and conveniently packaged for little more than a song, he lives the life of a plutocrat! Today, we need not be wary and cautious in our purchase, for the Pure Foods and Drugs Administration and the manufacturers combine to assure us our dollar's worth in spice from the time the product reaches this country until it gets to our grocery counter. The consumer leaves it up to the experts to judge the quality and nature of his cinnamon, too; and it takes an expert to tell a stick, or "quill," as it is called in the trade, of cassia-bark from cinnamon, for both of them curl as they dry in the sun. Cassia-bark is a red-brown color, while cinnamon is light buff; and though cassia-bark is preferred in this country, both are legitimately sold as cinnamon.

Westerners seldom visited Ceylon until World War II, but before then, they used to write rhapsodically about the cinnamon gardens, telling how, during blossom

time, the breezes would waft the delicate fragrance for miles around. Recently, one Singhalese student in the United States—more realistically, one might guess—remarked that the "blossoms stink."

But all agree that the bark is fragrant, and one of the charms of cinnamon is the pleasing aroma that comes when it is in the oven. When a pan of cinnamon buns is baking, this sweet, yeasty, pungent odor is every bit as enjoyable as the eating that comes later. Baking cinnamon buns is one way to make the kitchen the most popular room in the house, for it draws people like magic. At that moment, even a twentieth-century scientist could almost believe that cinnamon had supernatural powers! Gingerbread, cinnamon apples, and spice cake have something of the same tangy, pleasant smell. Interestingly enough, even today, cinnamon is the second most-used spice in the United States. For all of its long history, it has proved itself without peer in the realm of spices, which today are so numerous and varied that a medieval king would stare in wonder and amazement at the spice shelf in the ordinary kitchen.

▼ **BINDING CINNAMON** in Indonesia. The spice loses its flavor with age but less rapidly in this form than after being ground.

Information Service of Indonesia



American Spice Trade Ass.

▲ **LOADING CINNAMON** into a bullock cart in the Orient for shipment to Europe.



Afghan Profile

An expedition to excavate the past leads to fresh glimpses of a land from which American correspondents have recently been excluded

By
LOUIS DUPREE



Ann Dupree

▲ **BABA**, the kindly diplomat of the village of Badwan, with the author.

THE only really forbidding thing about Afghanistan is the lack of the overemphasized comforts of the West. Even to get to this Muslim country south of the Iron Curtain one must make the trip from Pakistan by truck or automobile over difficult roads, for the country has no railroad system. Once there, however, we find a people free of the superficial tinsel enveloping our civilization in the West. It was in Afghanistan that we found Baba.

Baba, whose real name is Ghulam Rasul, is the headman of the village of Badwan, located about 20 miles from the city of Kandahar in southwestern Afghanistan. Although Kandahar is the headquarters of an American engineering company (Morrison-Knudsen Afghanistan, Inc.), Baba's village,

at the time of our archeological expedition, had seen only two Americans, both engineers, and no other westerners.

The first time we saw Baba he was beaming. He always beamed when he had a problem to solve. His problem now was our problem, and our problem was that our truck had slid into an irrigation ditch outside Badwan. The truck was tilted at an angle over the bank. Baba and our interpreter, Ibrahim, were talking in Pushto, the official language of Afghanistan (along with Persian), and Baba was happily wagging his head from side to side and clucking "Ho, ho, ho" (Yes, yes) to whatever Ibrahim was saying. When the wagging and clucking was over, Baba turned and said a few words to the spectators. The men trotted to the

village, which was becoming indistinct as the sun dropped behind the surrounding black hills.

"They are going to the village to get shovels and picks," said Ibrahim. "This is the chief of the village of Badwan, where we will live. His name is Ghulam Rasul, and he wants to help."

At the mention of his name, Baba smiled. It was a happy, toothless smile, and the wrinkles on his tiny face pointed upward. Only once did I see those wrinkles pointing down in sadness.

Baba was about five feet one inch in height, weighing—in full chieftain regalia—a maximum of 115 pounds. He had close-cropped white hair, a magnificent white beard, a tanned and weathered face, and the youngest, brightest, proudest eyes I've ever seen. Most



▲ AFGHAN SOLDIERS assigned to protect the author's party. No protection was actually needed, because Afghan tribesmen are as friendly as they are fierce.

peasants in Asia age young, and the light in their eyes slowly goes out. But though the villagers said that Baba was over 80, his eyes were those of a young man.

We grinned at each other, and from the polar ends of 26 and 80 years, we repeated the formal Pushto greetings. As long as I knew Baba, we repeated these salutations every day, and he always looked as sincere as he did that first day.

When the villagers returned, Baba directed the pick and shovel operations. The truck was extricated, and we drove to the village.

Hospitality Plus

Let's look at it this way: suppose three Afghans arrived on camels at Skinner's Crossroads, Vermont, a mythical community consisting of a General Store and a population of 50 males. The Afghans are accompanied by a government official (a Democrat, in Vermont, at that). This gentleman and his three foreign wards an-



▲ WHEN the expedition truck slipped into an irrigation ditch, Baba (behind the soldier) directed rescue operations. Lack of roads forced the truck to be parked one-half mile from Badwan.

▼ BABA settling a village dispute while sitting atop a grain sack.



nounce that they plan to excavate certain American Indian caves near Skinner's Crossroads. To carry out this plan, they need a house to live in and workmen to dig the caves. How would their welcome compare to the one we received at Badwan?

First, Baba took care of our housing problem. We were shown to a new, four-room, mud-brick house. It was perfect for our purposes, and we were all set to move in when the local *mullah* (Muslim priest) appeared and began to argue violently with Baba. We learned that the *mullah* owned the house and had been planning to move in the next day. Baba had wanted to give us the best housing available. Under the circumstances,

we decided to decline. Another plan seemed more feasible. Baba owned a five-room, mud-brick storage house, only two rooms of which were occupied: sheep and goats in one, an Afghan sharecropper and his family in the other. We leased two rooms for ourselves and our equipment.

We had just finished unpacking when Baba arrived at our open door, followed by five of his villagers. They were the Village Council, the heads of the various clans, who had come to ask us why we wanted to live in their village. Obviously they had a right to know. We went into an empty sheep bin and squatted, Eastern fashion. I explained, through Ibrahim, that we were archeologists

and that we wanted to excavate a cave (Shamshir Ghar) near Badwan, to look for "old things." The council looked puzzled until I said that I wanted some men from the village to work for me.

Baba chuckled his tongue appreciatively and asked how much I would pay.

"Ten Afghan rupees a day" (about 25 cents), I replied. I thought this was generous. Laborers in the larger towns and cities generally received only five Afghanis per day. But I failed to reckon with the fierce independence of the back-country farmers.

Baba said sadly that he was sorry but that none of his people would work for such a low wage. This was the time of year, he explained, when the pomegranates were ripe, and any *boy* could earn fifteen Afghanis a day picking and packing the fruit.

Eager Volunteers

I was beginning to feel like a filthy capitalist trying to exact slave labor from an unenlightened peasantry, when Ibrahim turned to

me. "Baba says to tell the American to offer us thirteen," he said.

This I did with alacrity, and Baba accepted on behalf of his village. Immediately four members of the council applied for jobs; the fifth was too old.

To look at Baba was to see the mildest, sweetest of countenances, in whom aging had been a thing of beauty. A widower, he lived with his teen-age daughter, who cooked and kept house in mud-brick fashion for him. And from Baba the village drew its strength. He had come to Badwan only fifteen years before and for the past ten years had been headman. He was one of the few men in the village who had traveled beyond Kandahar, and he had ventured farther afield than any. In his youth, Baba had wandered as far north as Herat, and as far south as Quetta and Sukkur, in what was then India.

Like all good leaders, Baba also provided humor. Why didn't such a young man as he marry again, they constantly asked him. My daughter is for you, Baba, she

needs a real man, one would say. Baba would laugh at these sallies, and you could almost see him blush. To Badwan, Baba was a constant symbol of its strength and humor in the midst of a hard life.

That's why I was shocked when Baba came to me one morning with his beautifully lined face contorted and swollen, the wrinkles pointing down in pain. His left ear was infected. A hot, dirty infection. As many travelers have related, most easterners think every westerner is a doctor. I am not, but luckily we had a large supply of one of the newest antibiotics, terramycin. I prescribed what the instructions indicated would be a good dose for Baba and left the pills with his young daughter.

We went to work in the cave. At noon, the workmen walked to the village for their lunch, and when they returned they reported that he was still very sick. They were worried — and so were we.

Baba was even worse that evening. The villagers sat around his hut, counting their beads. The local *mullah* prayed for Baba. We increased the dosage. Religion and science, East and West, had met.

The next morning the swelling had started to subside, and the sparkle began to return to Baba's eyes. He smiled, and his wrinkles began to point up again. The village felt strong once more.

Baba was one of the few farmers in Badwan who owned the land that he worked, a fact which added to his prestige. As headman, he officially measured the harvested crops, and he was responsible for the pomegranate orchards of Badwan's biggest absentee landlord. In his position as master of the pomegranates, Baba kept us supplied with a day-to-day ration of that delicious fruit.

My wife, Annie, had a unique, though unwitting, way of earning her share. After a dusty day's work at the cave, Annie would splash, Bathsheba-like, in a stream that ran through the pomegranate orchard. Among the trees would gather the boys of Badwan — from

▼ BABA weighing grain for a landlord's agent. Baba protected his people from landlords who tried to charge too much rent.

Louis Dupree





Louis Dupree

▲ LONG-TAILED SHEEP, grazing in a pomegranate orchard. Boys and girls tend the sheep and goats.

6 to 60. When the performance ended, they would toss pomegranates. When Baba heard of such a disgraceful breach of decorum, he stationed himself in the orchard to keep away onlookers. He was apparently successful, yet after each performance, pomegranates continued to land on my wife's side of the stream. I never would have suspected Baba of having such a good throwing arm!

At night, the people of Badwan would sit outside their huts and tell stories by the dim light of their cooking fires, or, if too tired, they would fall asleep in their mud huts. Since we had a Coleman lantern, Baba would always spend a little time with us before going to the mosque for evening prayers.

Shaking his head and separating his beard with gnarled fingers, he would try to teach us Pushto. Patiently, he would repeat and repeat an extremely difficult tonsil-twister and cackle loudly each time we mispronounced it. We looked forward to those nightly lessons. Baba was teaching us the greatest lesson of the Orient — patience, tempered with humor.

Every *Juma* (Friday, the Muslim Sunday), the village prepared a feast of mutton and chicken pilau for us. Baba supervised, of course, and was at his diplomatic best.

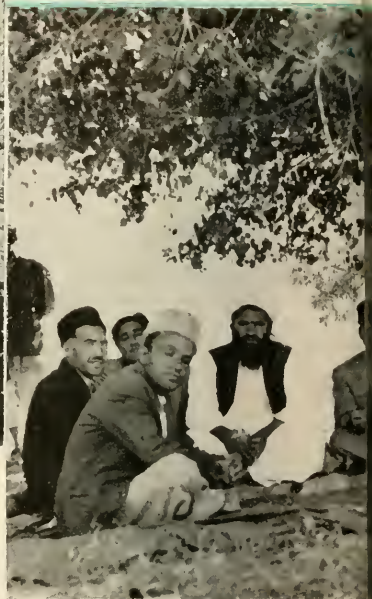
Occasionally, the governor of the sub-province of Panjwai and his staff would visit us on *Juma*. During these visits, between tea drinking and chess, we would explain to the officials that we were interested in archeology, not in gold and uranium.

Old-fashioned Courtesy

One time, a persistently skeptical visitor asked me how I could tell that such and such an artifact was older than another. Before Ibrahim could translate the question for me, Baba indignantly told the visitor that the American had spent many years learning these things and that the American couldn't teach him everything in one day. "I don't believe all that he says either," continued Baba, "but, after all, he is our guest!"

Yes, and the guests of Baba we remained throughout our stay at Badwan. Once we had to leave the village for ten days, and we left behind all our archeological equipment—clothing, cameras, and guns. When we returned, the room was just as we had left it. Baba had said: "While you are gone, nothing but dust will enter your house."

As the excavations drew to a close, I could not help but feel sorry. Badwan — and Baba — had been perfect hosts. TV would prove



▲ EVERY FRIDAY, the Muslim Sunday, the expedition with some of his friends.

a poor substitute for jaw-breaking Pushto by lantern light.

The morning finally came when we were to leave Badwan. I arose early and walked out into the cold December sunlight. Squatting by the doorless entrance, bundled completely in his loose-fitting, white wool coat, was Baba. His head was drawn, turtle-like, into the body of his coat, and all I could see were his bright eyes, peering at me from the darkness. He popped his head out, and we greeted each other as we had done, day after day, for the preceding eight weeks.

Baba's voice was sad, matching mine.

Our workmen and a number of the idle villagers gathered behind Baba, all squatting against the wall of our hut. They watched as we loaded our truck. When we had finished, Dr. John Zeigler, the expedition geologist, and I said goodbye to our workmen. We each embraced in turn, expressing our thanks for loyal and friendly service. With Baba it was different. We



Ann Dupree

Today, the governor of Panjwai visited is seen at right, in front of author.



Louis Dupree

▲ BADWAN PATHANS, some of whom worked at the excavations in a cave near Badwan. The man at right is shy.

our Kandahar house opened, and in walked Baba and Nasar. We embraced, and then Baba embraced Annie, and touched her blonde hair. The old devil blushed to the roots of his whiskers. He must have been waiting such a chance since the pomegranate episodes!

Baba had traveled the 20 miles from Badwan and Kandahar on top of an ancient lorry to pay his official respects to the new governor of Kandahar, and before returning he had stopped by to have a cup of tea with us.

Pilgrimage

As we talked of trivial matters, I could see that Baba had something important to say—and finally, he burst out with it: "Next year I will make the *Haji*," he announced triumphantly. This meant the pilgrimage to Mecca, the Holy City of Islam, one of the religious duties of every good Muslim. To enable himself to make this trip, Baba had

saved for many years. The pilgrimage would raise him to an even higher position in his village and throughout the Muslim world. All True Believers would call him *Haji* — one who has made the pilgrimage. His name would change to *Haji Ghulam Rasul Badwani*. "But to my friends, I will be *Haji Baba*," he laughed.

The last we saw of Baba he was leaning down and waving from the top of a loaded lorry, going back to Badwan. Back to where his strength was needed.

"*Ghodai pomon*, Baba."

Thus we had seen an important man in daily life. There are thousands of village headmen in the Middle East, and they must be politicians, tax collectors, judges, father-confessors, union organizers, as well as first class farmers and shepherds. Understanding the human qualities of men like Baba will help us understand the Middle East a little better.

were saying "so long" but not "good-by," to an old, old friend.

What happened next must be considered in the light of Muslim customs concerning women. Afghanistan is one of the few Islamic countries that still requires its women to be veiled, and women still occupy a definitely subsidiary position in Muslim society. Few Muslims will publicly display any regard for a female, even for their own wives. But Baba came up to Annie, shook her hand and told her that he would miss her. Nasar Muhammad, assistant headman and our labor foreman, emboldened by Baba's act, quickly and embarrassedly shook her hand. No one else dared join in this breach of tradition. Instead, the Badwans good-naturedly jeered and cheered.

We drove away with cries of "*Ghodai pomon*" (God be with you) in our ears.

However, we had not seen the last of Baba with the bright brown eyes.

Two months later, the door of



Readers of NATURAL HISTORY will remember LOUIS DUPREE's earlier article, "Who Saw the Sch'goon?" in the December, 1955, issue. The present article was likewise an outgrowth of an archeological expedition in Afghanistan under the American Museum of Natural History. Dr. Dupree is now Associate Professor of Middle Eastern Studies, Air University, Maxwell Air Force Base, Alabama, and a Research and Editorial Specialist at the Arctic, Desert, Tropic Information Center, Research Studies Institute.

The Cave of

Want to explore a cave? This one in Venezuela holds thrills enough—a water passageway, awesome caverns piled high with beautiful mineral formations, and last but not least—strange, nocturnal birds that leave the cave only at night for food

By JEANNE AND RUSSELL GURNEE



▲ JEANNE GURNEE, DESCENDING a 30-foot pit by means of a cable ladder she and her husband secured at the top.



Werner Cohnitz

▲ THE CHIAMIA INDIANS used to enter the cave once yearly for an "Oil Harvest" which was preceded by religious rites. The entrance is 85 feet wide and 75 feet high.

he Guacharos

THE screams and shrieks of the birds were deafening. We were standing in the complete blackness of a limestone cavern surrounded by thousands of hawklike birds, which were flying fitfully around us. These were the strange Guacharos (*Steatornis caripensis*), the only birds in the world to choose caverns as their home, leaving them only at night for food. In addition to this odd selectivity, they are reported to be found only in Venezuela, Colombia, Ecuador, Peru, and on Trinidad Island.

"How can the birds carry on their daily activities with complete absence of light?" "What would prevent them from crashing into obstacles in the dark?" "What are their nests made of?" "Where and what do they eat?" "What other animals share the inky blackness of the cave with the Guacharos?"

It was our fascination for the bird combined with an interest in cave exploration that brought us to Caripe, Venezuela, to see the conditions surrounding the life of the Guacharo.

Five years before, we had first become interested in caves when we began seeing black openings in the mountains along the Pan American Highway coming north from Mexico City. Soon we were

climbing on burro-back to Garcia Cave in Monterrey, Mexico, and we visited all subsequent commercial caves on our homeward trip.

Each February since then we have been fortunate enough to spend a vacation "caving" either in this country or Yucatán, and now Venezuela. During the remainder of the year, weekends are crowded with traveling to, and crawling through, caves near home with other members of our local "grotto" of The National Speleological Society. All cavers, whether they are speleologists (people scientifically interested in caverns and their life) or spelunkers (those who explore caves for the sport), are drawn together by an inherent and insatiable curiosity about the unknown. In a way, caves represent one of the last frontiers, with thousands of caverns still holding many unexplored depths that may reveal secrets of past civilizations as well as valuable geological and biological data. In this atomic age they are also becoming valuable as storage areas.

In one of the Society's publications, an article by Dr. Eugenio de Bellard Pietri, Venezuelan speleologist, told of a cave containing a colony of birds also seen and described by von Humboldt who



Shell Co. of Venezuela

▲ ONE of the strange Guacharos, *Steatornis caripensis*.

visited the cave in 1799. Their uniqueness interested us so much that we soon found ourselves planning to investigate them. The trip took us first by plane with 88 pounds of baggage (about 50 pounds of it cave gear) and then 17 hours by jeep with our kind host, Gene de Bellard, over the roads of the Venezuelan interior. Lush rain forests and barren plateaus flanked the road on our drive to the valley of Caripe. There we found ourselves in a spelunker's paradise, for the limestone mountains round about were rich in caves.

After a few hours' sleep, we approached the cavern of the birds. Large stalactites near the entrance were covered with green growth, a strange bridging between the lush vegetation outside and the cool, dark gray sterility within. A clear stream issued from one side of the opening and tumbled over

▼ THE GURNEES RECONNOITER for the best way across the water.





▲ THE VALLEY OF CARIFE, VENEZUELA, is a spelunker's paradise. The limestone mountains are rich in caves.

➤ MASSIVE STALACTITES FESTOON THE ENTRANCE to the cave, as one takes a backward look from the bank of the shallow stream that flows through it.



the rocks outside. We were excited.

After checking our flashlights, we lit our carbide lamps and snapped them on our helmets. A few thuds on the head from projecting rocks soon teach would-be cavers that a helmet is one of the most important items of equipment.

While we laced our knee-boots, Ramón, our guide, slid off his woven sandals to explore barefoot. Presently we were splashing our way up a wide stream. Ramón went ahead, lighting our way with a lamp. Mineral-laden moisture, slowly dripping from the ceiling through the ages, had created fabulous formations in this mile-long tunnel, turning what might have been a barren subway into one of the most fascinating caves we had ever seen. Mounds of massive stalagmites and stalactites covered the floors and ceiling. As we walked along, we glanced periodically at the water. Once Gene de Bellard exclaimed he saw something moving in it. He stooped down and came up with a crab, its appendages wriggling in space. Although some shellfish do live in caves, this type was believed to have been washed in from the surface. However, we soon found colorless catfish approximately five

inches long. We have seen catfish in other caves also. In Yucatán they were quite a bit larger.

As we moved out of the sight of light, we came to what seemed to be the end of the long entrance room. The passageway closed down considerably, and as we contemplated the complete blackness of the way ahead, we began to hear odd but distinct sounds. To a cave explorer it was particularly strange, because most caves, in addition to being completely black, are silent. As we passed to the next room, a shocking series of cries issued from the darkness, and we knew that unseen creatures were all around us. Here, finally, were the Guacharos.

A Host of Unseen Creatures

Thousands of rattling voices filled the air with such continuity that they became a sea of ear-splitting noise. While we tried to accustom ourselves to it, we shined our lights upward. The ceiling was so high (120 to 150 ft.) that a flashlight beam was lost in the blackness. We knew that the birds were looking down from the ledges near the ceiling with a sensitivity beyond man's powers.

We had, meantime, come out of

the stream and were standing in a white forest of seedlings several feet in height. We examined the floor and saw thousands of palm nuts scattered there. Some had germinated in the rich cave earth, which was composed mostly of the guano of the birds. Without sunlight, however, the seedlings had soon died and withered away. The nuts revealed the birds' dietary tastes. The Guacharo is a nocturnal bird; each night he leaves the cave and travels to areas where these palms are plentiful. Eyewitness accounts tell us that single Guacharos have been seen silhouetted against the night sky, hovering near a cluster of palm fruits, not unlike immense hummingbirds. The Guacharos have a noiseless, loping flight. Botanists have studied the palm nuts in the cave and attempted to locate the feeding grounds. Humboldt, the famous scientist-naturalist, estimated that these birds traveled as far as the Orinoco valley for forage, and present-day accounts tell of hearing their screams over the oil fields of Maturín, 60 miles away.

The Guacharos continued their raucous outbursts as they flew. We could see some sitting haughtily in their nests, necks outstretched,

peering down at us. We turned out all our lights, then, and stood in a thick blackness more complete than anything experienced above ground. Time, space, and sound were deceiving, and the clacking sounds continued to echo everywhere from the vaulted galleries.

While the birds of Guacharo cave were what we had come more than 3,000 miles to see, we were not prepared for the singular beauty of the cavern itself, and we decided to explore it further. Their cries died away in the distance as we crouched down through a narrow passage and followed the stream along. Climbing up and over a slippery mountain of guano,

we entered Precious Hall. Its name gives only an inadequate idea of the magnificent and colorful formations. The room was estimated to be 600 feet long and 60 feet wide.

We located a pit at one end. Flashing a light down, it seemed to be about a 30-foot free drop to the floor. Securing a cable ladder to the top, we descended to a small passageway. We crawled along and came to another pit. Jeanne chimneyed down another fifteen feet into a hole lined on all sides with beautiful, translucent orange crystals. Along one side our lights reflected against some almost four inches long. Crawling on again we

climbed up a tight passageway through a low-hanging curtain of stalactites to another black pit. About it were some of the most weird and erratic formations we had ever seen. These so-called helectites extended precariously in space from one joining place at the ceiling. One resembled a bird in flight. How helectites are formed is still a mystery to be solved by speleologists. A caver, whether he be a naturalist or athlete, could not help but find fulfillment in this cave. Having done some exploring, we climbed out of the pits and returned again to the noisy room of the Guacharos.

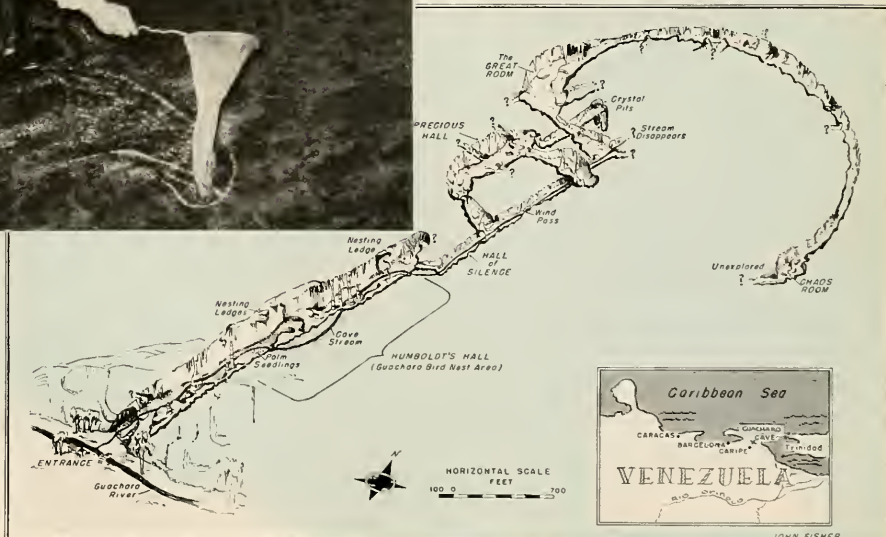
Something small ran over our



◀ DR. EUGENIO DE BELLARD PIETRI, the most active "spelunker" in Venezuela, collecting specimens from the cave's stream. One is seen below.



A PERSPECTIVE MAP of the cave, showing its principal passages and halls.





◀ AFTER DESCENDING this pit, Jeanne Gurnee found another one, lined with beautiful translucent orange crystals.

▼ THE AUTHORS pause in their exploration of the inner parts of the cave.



feet in the darkness. We snapped on our lights to reveal a cave opossum scurrying busily about his affairs. This fellow was fairly sociable, in fact, about the most friendly inhabitant we were to meet, and after sliding hazardously in the guano, we caught one of the creatures for closer examination.

Our thoughts kept going back to the fanciful Guacharos which, though we had spent many hours with them, had not descended in flight lower than 30 to 40 feet above the cave floor.

"I can see why these birds have rarely been photographed," said Jeanne; and I had to admit that the prospect of getting pictures looked pretty grim.

The profile of this room was somewhat like a lopsided cathedral. The left hand wall sloped upward at about a 70-degree angle; and it would be physically impossible to scale it. The right wall was practically vertical. The flat ceiling was pitted and pockmarked with water-worn holes and loomed 150 feet above us. The nests of the birds were easy to identify by the dark streaks of droppings, which showed

they had chosen the most inaccessible ledges near the ceiling.

"Well, it's impossible to see very much from here. Let's see what it looks like from above," I said. With my camera case over my shoulder, I recharged my headlamp and started to look for a place to climb.

In approaching the wall, you had to walk ankle-deep through a black, shiny mass. Near the wall, I found that it was covered with flowstone, a smooth calcite cave formation. I chimneyed up a crevice nearby and, once there, found enough handholds to continue. About 50 feet up, a ledge 7 or 8 feet wide extended for 30 or 40 feet along the cliff. Looking down, I saw Jeanne's headlamp clearly; and when I looked upward, my light set off a renewed burst of screams from the birds above. I called to Jeanne, but she couldn't hear me over the racket of the Guacharos.

Left by Indian Oil Hunters

At this point, I came upon a long, rotted pole about 4 inches in diameter and 30 feet long. The story of how it had gotten there

flashed to my mind. Many years ago the Chiama Indians of the area used to enter the cave once yearly at the time of the "Oil Harvest." Young Guacharo birds, being unable to fly, have very little activity, and the oily diet fed by the parent birds causes them to become extremely fat. This fatty substance when rendered out gives a remarkably pure oil for cooking purposes. The Guacharos are also called "oil birds" for this reason.

The Indians would enter the cave, knock the nests down with these long poles, and slaughter the birds for the small amount of fat that each one would yield. Some of the poles were used as an aid in climbing to these precarious ledges, and occasionally more daring Indians would span the upper portion of the cave by wedging the pole across from ledge to ledge and monkey-climb to the opposite wall. The pits below have been named for the unlucky ones who failed. In recent years, the Venezuelan government has made the cave a national preserve, Humboldt National Park, and cave guards and guides protect its inhabitants.

Baron Alexander von Humboldt, for whom the area was named, came to the cave in September of 1799 and was the first to present a serious study of the birds, as well as the cave itself. Other scientists have succeeded him in the study of the habits of the birds, including Anton Goering, William H. Phelps, Dr. Eduardo Rohlf, William Beebe, R. Johnson, and more recently Professor Donald R. Griffin of the Department of Zoology at Cornell University, who discovered the method by which these birds fly in complete darkness. They locate the walls by an echo system somewhat similar to radar. The system can be compared to that of a bat, with the exception that the bat emits sounds that are almost entirely inaudible to man. As I stood clinging to the wall, I distinguished in addition to the screams of the birds a second, fully audible typewriter-like ticking

made by the birds in flight. This was the sound by which they avoided obstacles in the dark. Echoing back from a wall or other obstruction, it would warn the bird's sensitive ear that he must alter his course. Thus, the Guacharo's audible ticking noise is his sonar system. The birds are able to determine the distance of the obstacle by the time it takes the echo to return. Griffin found that by plugging the birds' ear canals, they tended to lose their sense of orientation. From this it could be concluded that their perception is auditory. Experiments by Griffin and Phelps in a lighted room showed that Guacharo birds can see, for they flew using eye perception. However, when they approached a dark-colored wall, they used echo-location as an aid to flight.

As the birds ticked and screamed through space, I speculated on how

I could judge distance, focus, and fix exposure on an object flying around at a high speed in absolute darkness. Climbing again, the going became more difficult. The wall was now perfectly vertical, and I was still 40 feet from the ceiling. I found another handhold and fortunately saw another pothole chimney. If I could only get up another five feet! I looked upward and saw that the top portion of the cave narrowed to about 20 feet. Below, I found I could see the nests of the birds on the opposite side. The birds were looking at me like fat pigeons. They were about the size of a hawk and reddish-brown in color. The reflection of my light made their eyes shine like translucent red marbles. In flight, their wingspread was about four feet.

Inching upward, I suddenly saw an opening in the wall and slipped into it. It was actually a miniature cave within a cave, and it gave ac-

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WHAT THE AUTHORS HAD COME TO SEE—the unique oilbirds of Venezuela. Reddish-brown in color, they sport white spots on head and wing. Long, thin feathers projecting whiskerlike from the bill resemble those of the whippoorwill. At right: one of the nests, perched near the ceiling, 150 feet above the cave's floor.

Shell Company of Venezuela





▲ A SOCIAL VISIT to a giant grouper's underwater cave-home. The floating object in the background is not a strange inhabitant of the sea but a cluster of flash bulbs ballooning to the surface.

The Beautiful **and DEADLY**

By ARTHUR C. CLARKE

*The Scorpion Fish, one of the most dangerous
in the sea, is also one of the most beautiful — and approachable!*

MIKE and I put on our aqualungs, adjusted our cameras, and sank slowly to the bottom. The scene was the beautiful bay of Trincomalee in Ceylon, not far from a precipitous headland known as Swami Rock and near a submerged Hindu temple. But interesting as the latter was, it was not the object of this dive. The water was so clear that it was easy to make out the main details of the flat sandy sea bed 45 feet down. Yet except for the Hindu temple, it seemed completely barren, a submarine desert without a trace of life.

Soon, however, our goal came into view — a rusty, broken sphere about four feet in diameter — the remains of a buoy that had sunk many years ago. It was now nothing less than a major housing project. This seems to be the fate

of all hollow objects that man abandons to the sea, from tin cans to luxury liners. One wonders how certain fish managed to get along in the millions of years before there were any wrecks! As the broken and corroded buoy approached, I could see that the entire top was missing, and that the interior was so crowded with scorpion fish that it was remarkable how they managed to avoid stinging one another.

Perhaps it should be quickly explained that the fish in question, upon contact, ejects poison through one of its spines in a purely defensive action. It is also called the Butterfly Cod, and the Lion, Tiger, or Zebra fish and is seldom more than a foot long. A predator, it eats only live fish captured by a curious technique. Seeming to hypnotize its prey by waving its fins before it, it suddenly opens its

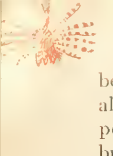
mouth and swallows the victim whole.

I first met the scorpion fish while aqualunging on the Great Barrier Reef—that 1,200-mile-long chain of coral which is one of Australia's greatest natural wonders. I had crawled into a small cave some 30 feet below the surface to pay a call on a giant grouper who lived there. (He wasn't in at the time.) I was examining the cave when my eye was caught by a movement just overhead. What looked like a bundle of turkey tail-feathers was orbiting in a leisurely fashion a few inches above me. I realized at once that I was looking at the scorpion fish's dangerous spines.

Unless I accidentally knocked against the little creature, however, I knew that it would do me no harm, and for some minutes we quietly surveyed each other. I then

▼ THIS SUNKEN BUOY is the home of the scorpion fish visited by the author.





became ambitious and optimistically tried to capture it. The only possible tool was my snorkle breathing tube. Had there been any spectators, they would have been entertained by the clumsy spectacle of the fencing match that ensued. When I tried to hook it with my snorkle, it neatly sidestepped, until tiring of the game it disappeared into one of the cavern's smaller recesses.

Now, off Ceylon, I was approaching a whole colony of this fascinating fish and could study their behavior at close range. Swimming slowly around, they were fluttering their feathery spines like Edwardian ladies showing off their frills in an Easter parade.

As we came nearer, the fish began to pour out of the buoy to get a look at us. Now a great many fish are inquisitive, but most are also shy and will retreat hastily if you come too close. These scorpion fish, however, while inquisitive, showed no trace of shyness. They acted as if they had no enemies in the world and could not imagine that anyone would want to harm them. (They may have been right!)

They still showed no signs of alarm when flash-bulbs started popping all around them; indeed, they began to ogle the cameras as persistently as the crowds around a mobile TV unit. It would have been hard to find more co-operative subjects, above or below water. Our only problem was to make sure that while we were busily focusing on one fish we were not getting into poisonous proximity to another.

After a while we stopped shooting into the interior of the buoy, and Mike Wilson, my partner, lay on the sand about six feet away so that he could compose some long shots in comfort. At once a small caravan of scorpion fish began to wend its way towards him, until almost a dozen of the creatures—from babies three inches long to grandpappies two feet across the spikes—were ranged round Mike in a semicircle, all

watching to see what he would do next. They reminded me irresistibly of puppies wanting to join in a game or be taken for a walk.

By this time we had developed the friendliest of feelings toward the fish and were beginning to look upon them in a proprietary manner. Several times Mike almost touched one of the smaller specimens with his gloved hands. Each time, it ruffled its spines a little but showed no great alarm beyond retreating a few inches. The only thing that did seem to annoy them was a very small, brilliantly blue fish which acted as a gadfly, darting at them and biting their skin. In a spectacular bit of mistaken identity, one of these little bullies attacked me, and for a fish only an inch long it managed a nasty nip.

Poison—Do Not Touch!

But that was nothing to what these amiable little scorpion fish could have done, had I come into contact with them. For a firsthand account of what it feels like to be stung by *Pterois volitans* (its scientific name), I went to Rodney Jonklaas, the famous Ceylonese underwater marine collector. Rodney has netted dozens of scorpion fish for aquaria, not always without contact.

His technique while swimming underwater was exactly the same as a butterfly catcher's. Carrying a small net in his left hand, he would use his free right hand to scare his victims into captivity. One day he had just trapped a medium-sized scorpion fish in this manner when it suddenly backed out of the net, and one—just one—of its poisoned spines barely penetrated the skin at the joint of Rodney's middle finger.

An excruciating pain at once spread over his hand, but he managed to recapture the fish and get ashore. For a moment the pain ebbed; then, in even more intense form it returned, until his entire arm became numb. His fingers were swollen and stiff, and soon he was in such agony that he lost consciousness. When he came to

about ten minutes later the pain was still there; it was half an hour before he could get medical treatment at the Colombo Zoo, of which he was at the time Deputy Superintendent. The treatment consisted of drinking dilute ammonium chloride, after which the pain quickly subsided. There were no after effects.

A second occasion was very similar, but this time the pain was not so intense, and though it lasted for a couple of hours, it was not incapacitating. And a third time the sting gave Rodney no trouble at all—though it would seem too rash to assume that he was building up an immunity, for in both of these cases the stings were quite trivial.

It seems highly probable that if one were unlucky enough to get a good dose of the scorpion fish's poison, by being pierced by several of its spikes at once, the result would be fatal. Perhaps the remark about its relative, the Australian stonefish, also applies here, "It's not really poisonous, but the pain kills you." This could certainly happen to an aqualunger who came into contact with one of these creatures at any depth: the shock might easily cause him to lose his mouthpiece and he could drown before reaching the surface.

The fishermen of Ceylon have a great dread of this fish; there is at least one reported fatality caused when a man stepped on a dead specimen. But as is usually the case, no one can supply names, dates, or places, so the fish's lethality is still not proved.

Unproven though this may be, I like to feel that I have proven something: one of the most dangerous animals in the sea is also the friendliest. Perhaps I am too trusting in these matters, but when I remember how they all filed out of their battered home and gathered round our flipped feet, I like to think that they simply wanted to make friends. One of these days I'll look forward to making their acquaintance again—from a minimum distance of at least twelve inches, of course!



▲ A SCORPION FISH comes to take a look at the aqualunged intruder.



▲ RODNEY JONKLAAS cautiously nets a scorpion fish.

▼ UNAFRAID, even cooperative, scorpion fish gather around Mike who photographs them from a comfortable, reclining position.



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BOOKS continued from page 512

fossil remains. However, so great is the number of biologists, anthropologists, and hunters of fossils and prehistoric artifacts in the pages of this book that in the minds of some readers at least, the stories of these men and women will coalesce into a somewhat confused mass. Saddest of all is the abundance of slips and mistakes. It is jarring to read that in 40 years Morgan and his colleagues bred 10,000 generations of *Drosophila* flies, the famous subjects of genetic research. The number is too high, as it is when these men are said to have recorded over 200 million of the flies and that in four years *Drosophila* produces as many generations as mankind has produced from the end of the Ice Age down to the present. There are many other slips of this kind.

The latest work of the reviewer (the eminent biologist and author of *Genetics*, and the *Origin of Species* 1937), is *The Biological Basis of Human Freedom* (1956).

KINGDOM OF THE BEASTS

by Julian Huxley
and W. Suschitzky

Vanguard Press, \$12.50
159 pp., 175 photogravure plates

Reviewed by T. DONALD CARTER

THIS book could appropriately be entitled "Portraits of Living Mammals," for the majority of its photographs are exceptional head studies of various mammals found in European zoological parks. Mr. Suschitzky has been fascinated by animals since childhood, and his pictures give evidence of this keen interest and his skill as a photographer. Taking pictures of animals in a zoo is a simple matter, but to get a series of pictures in such sharp focus that textures of hair and unique facial expressions can be studied requires the utmost patience and ability. Patience and ability have been justly rewarded in this collection of photographs.

As might be expected, Julian Huxley has written a very readable and authoritative text to accompany the photographs. On the first pages of the book there is a brief but comprehensive review of the history and relationship of mammals, with short descriptions of some of the more interesting mammalian fossils. These descriptions are in conjunction with a series of photogravure plates made from Mr. Suschitzky's photographs.

The second section of the book, entitled "Animal Photography," written by Mr. Suschitzky, explains the type of camera and films he considers best fitted for this work and gives other information which should prove helpful to any person entering this special field of photography. He also relates numerous interesting anecdotal

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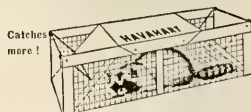
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dotes of his experiences during his twenty years of taking animal pictures.

In the third section Mr. Huxley gives a brief description of some interesting facts about the animals whose photographs appear in the book. The publisher deserves great credit for the excellence of the reproductions and the format of the book. It would have been helpful, however, if the name of the animal appeared on each plate.

T. Donald Carter is Assistant Curator of Mammals at the American Museum of Natural History. His published works include, Hoofed Mammals of the World (1953).

CHILDREN'S BOOKS

In response to enquiries regarding young people's books that can be recommended

as Christmas gifts, the following titles are suggested by Miss Marion Carr, the Editor of *Junior Natural History*:

THE SEA AND ITS RIVERS, by *Alida Malkus*, Doubleday & Co., N. Y., age 12-16, illustrated, \$2.75.

THE STORY OF CAVES, by *Dorothy Sterling*, Doubleday & Co., N. Y., age 8-12, illustrated, \$3.00.

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THE STARS, by *Irving Adler*, John Day Co., N. Y., age 12 up, illustrated, \$2.95.

INSECTS IN THEIR WORLD, by *Suzan Moguchi Swain*, Garden City Books, Garden City, N. Y., excellent for identification purposes for the beginner, age 8-12, illustrated, \$2.50.

DESERTS, by *Delia Goetz*, William Morrow & Co., N. Y., about plants, birds, mammals, reptiles, and people of the desert, age 8-12, illustrated, \$2.00.

TRUE-TO-LIFE STORIES, Juvenile Series by *Dr. R. W. Eschmeyer*, A. S. Barnes & Co., N. Y., each about a fish, bird or mammal, with stories of our country's renewable resources, age 8-12, \$1.00 each: **FREDDY FOX SQUIRREL**, **CHARLEY COTTONTAIL**, **BOBBY BLUEGILL**, **WOODY WOODCOCK**, **WILLIE WHITETAIL**, **AL ALLIGATOR**, **TOMMY TROUT**, **BILLY BASS**, **MAC MALLARD**, **BOB WHITE**.

THE STORY OF THE ICE AGE, by *Rose Wyler* and *Gerald Ames*, Harper & Brothers, N. Y., age 8-12, illustrated, \$2.50.

CAVE OF RICHES, by *Alan Honour*, Whitelsey House Book, McGraw Hill, N. Y., a story about the finding of the Dead Sea Scrolls by a Bedouin boy, age 8 up, illustrated, \$2.75.

THE CAVE OF THE GUACHAROS

cess to a ledge which was within six feet of the ceiling. Flashing my light around, I saw one of the nests projecting from the near-by sheer wall. It was approximately one foot in diameter and was a shallow bowl of smoothly packed mud. No bird sat on the nest. The owner

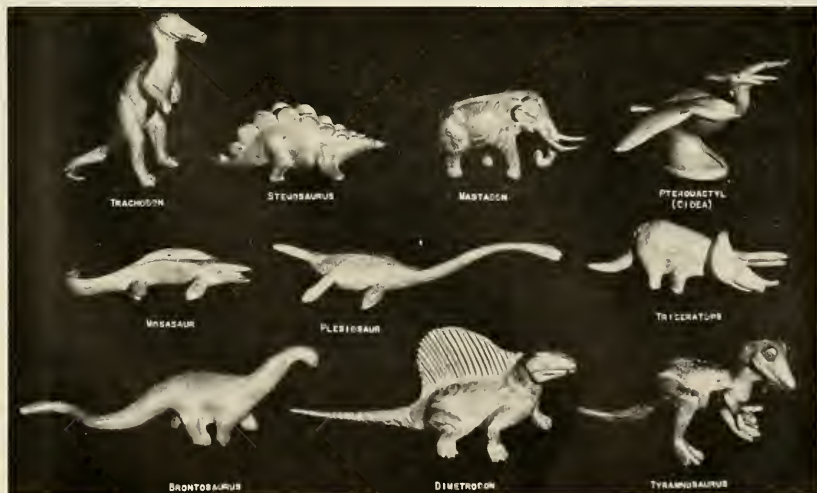
continued from page 547

was no doubt lying frantically in the air, waiting impatiently for my retreat.

I took photographs of the nest and the birds in flight, while the birds themselves did everything except cooperate with me. The Guacharos are curious by nature and

they flew quite close to observe me. Their ticking and cries indicated their approach, but they would wheel suddenly out of range when I hoped to photograph them.

Later the next problem presented itself: how to get down. The getting down in this case was going to be more difficult than the



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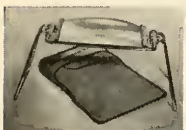
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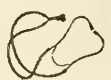
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getting up. The vertical wall which, viewed from the bottom, appeared to be straight up, now seemed to be an overhang; and Jeanne's tiny headlight was a little dot at the bottom of a pit. I lowered myself over the edge of the first ledge, feeling out the footholds with my slippery, muddy boots. When I could wedge into a crevice, I would feel a sense of security; for even though it was 50 feet deep, I could hold myself in by friction.

Which way had I come up? I called to Jeanne, but she could not hear over the screams of the birds. I continued down cautiously.

At last I reached the ledge with the long sapling used by the Indians. Should I attempt to use it for my descent? Discretion was the better part of valor, and I decided to take my chances on the handholds and crevices that nature had provided.

As I went over the edge again I realized suddenly that this was not the same route I had taken up. After another ten feet there seemed to be no more handholds. The rocks which had fortunately been quite clean near the roof of the cave, were now smooth as soap, although not as clean, and so I thrashed about like a frog in a well.

Jeanne, watching my descent, came up the slope under the place where I was hanging and called out directions for gaining footholds. In this way she succeeded in getting me down to where I could gracefully fall knee and elbow-deep in the soft guano.

By now the din of the birds had increased in tempo and the entire population was awake. Glancing at my watch I realized that night was falling and that the birds were getting ready to leave for their evening feeding grounds.

We waded down the little stream toward the entrance and took up a vantage point on a high rock to await the exodus of the birds. Sitting in the total darkness, we could hear some "scouts" approaching the entrance. As they ticked in staccato rhythm, they sounded like flying

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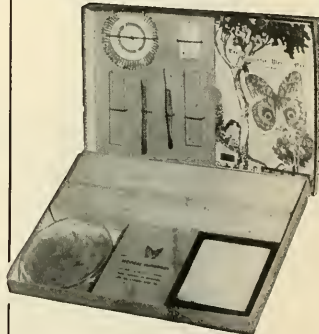
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geigers looking for something to count. These few birds circled out into the dusk, their bodies silhouetted against the sky, and then flew back into the second cave room. A second group came out and repeated the procedure, ticking as they flew back into the cave again. The sky grew increasingly dark.

Finally a larger number of Guacharos could be heard approaching the entrance in a black wave. They flew out into the night and did not return. There was a lull, and a second wave of birds flew out into the night. By that time the sky no

longer could be distinguished from their bodies and a steady stream of birds was disappearing into the sky.

Before dawn lit the sky, the Guacharos, which normally never see the light of the sun, re-entered the cave to spend their daylight hours, too, in perpetual darkness.

While the birds settled on their vaulted ledges for another day, we passed from their roosting room to the entrance hall. Their cries became a faint echo; and as we turned our backs on the oil birds of Venezuela, we both felt we had witnessed a strange and awesome phenomenon.

THIRST continued from page 518

any extension in survival time over that to be expected by a man drinking no water at all.

The sea-water enthusiasts argue that Dr. Alain Bombard drank sea water and survived; therefore, sea water must be beneficial. What was Bombard's experience and how does it compare with that of shipwreck survivors? Bombard departed from Las Palmas, Canary Islands, on October 19, 1952, and landed at St. Lucia, Barbados, on December 23, 1952—a journey of 65 days. But 52 days after setting out, he boarded the S. S. *Aroka*, stayed an hour and a half, and had a meal. These 52 days represent

his longest period of survival without outside help.

Bombard's voyage was a truly remarkable exhibition of fortitude and an impressive demonstration of the capacity of the human body to withstand abuse. However, several shipwreck survivors, less well prepared than Dr. Bombard, have made longer drifts.

The longest drift on record is that of Poon Lim, a native of Hong Kong, who spent 133 days on a raft in the South Atlantic after his ship, the S. S. *Ben Lomond*, was torpedoed in 1942.

Poon Lim spent the first hour after the torpedoing floating in his life jacket. Then he had the good fortune to reach an unoccupied raft. The raft had food and water for 50 days—but the last 83 days of his drift he subsisted on rain water and fish. Brazilian fishermen picked him up, still in good physical condition after 133 days on his own.

Has the survivor no choice but to rely on rain water as Poon Lim did, or take a chance on sea-water poisoning as Bombard did? Fortunately, most survivors of ditchings or shipwreck will not be limited to these alternatives. Two devices developed during World War II give today's survivor a margin of safety—the desalting kit and the solar still.

The desalting kit provides a method of converting salt water to

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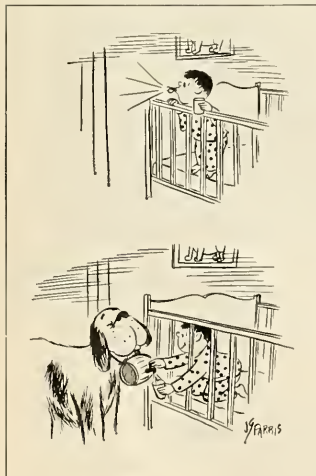
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fresh in practically any weather, but it can be used only once. The solar still functions only when the sun is shining or under a light cloud cover, but it can be used indefinitely.

The desalting kit precipitates dissolved salts in sea water so that they can be filtered out. Each desalting kit contains a number of briquettes of silver aluminum silicate and a plastic processing bag. Each briquette will desalt about a pint of water. The kit will produce six or seven times as much water as could be carried if the same space were used to carry canned water.

In use, the processing bag is filled with sea water up to a marked line and the briquette dropped in. The bag is kneaded and agitated gently for an hour, allowing the briquette to break up and the chemical reaction to take place. Desalted water is drawn off through a filter in the bottom of the bag,

from which it can be drunk directly or squeezed into a storage bag.

The solar still is a spherical plastic envelope that can be inflated either by mouth or by using the pump carried on most life rafts. Inside the sphere is stretched a black cloth, upon which sea water drips from a reservoir. The sun heats the moist black cloth, and from it the water evaporates—fresh. The evaporated fresh water condenses on the inner surface of the plastic sphere in small drops, which run down to the fresh-water trap at the bottom of the still. The salt stays in the black cloth.

Each solar still can produce about two pints of fresh water a day, and most life rafts on aircraft carry several stills. Each still takes up about the same amount of space as a pint of canned water.

The stills operate most efficiently in direct sunlight but will operate on cloudy days if the overcast is not too thick. They will not operate at night or on very dark days.

The map on page 517 shows how much help can be expected from

rain in various parts of the world. Rain plus the water from the solar stills usually yield between 80 and 130 per cent of the requirement for survival in almost all areas commonly traversed by planes and ships.

Desalting kits provide an additional supply to carry castaways through periods of unfavorable weather. The inherent ability of the human body to withstand abuse provides a further safety factor.

In view of the resources now available to the castaway, it seems foolish to recommend that a survivor drink sea water. In most emergencies, he will drink some accidentally, and a certain amount of dried salt is also taken in. This unintentional salt would, in most cases, nullify the meager benefit that might be gained from drinking sea water. The drinking of sea water, then, is just another of the recurrent fables that should be given a quiet burial. Man is no more able to drink sea water than Coleridge's Ancient Mariner.

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